RESUMEN

El *Centro de Diseño de Equipos Industriales* de la *Universitat Politècnica de Catalunya,* encargó a Orion Houghton Villoldo, ingeniero de proyecto de CDEI, el desarrollo del estudio de viabilidad, el proyecto ejecutivo y soporte en la dirección de obra, puesta en marcha y ensayo de una instalación solar térmica experimental de colectores cilindro parabólico, de 30 kW de potencia térmica, para aplicaciones de generación de electricidad, calor y frío solar en edificios terciarios, bajo la dirección de Huáscar Paz Bernales, jefe de proyectos del CDEI, y Carles Riba i Romeva, director del CDEI.

La instalación solar térmica experimental se compone de un sistema de colectores cilindro parabólico, de 41 m^2 de apertura, que genera anualmente en torno a 35 MWh para configuración Este-Oeste, y en torno a 40MWh para configuración Norte-Sur, con emplazamiento en la provincia de Barcelona, y con una temperatura máxima de servicio de 250ºC y con presión de servicio próxima a la atmosférica. Los trabajos realizados incluyen un análisis del estado del arte, de las alternativas de configuración y de mercado; una simulación energética; un análisis energético de un ensayo experimental; el predimensionado de la instalación, sus equipos y accesorios; el desarrollo preliminar de planos y esquemas; las mediciones y presupuesto; un estudio del programa, un estudio ambiental y, finalmente, un estudio económico.

Las tecnologías de colectores cilindro parabólico para aplicaciones de calefacción y refrigeración solar en edificios residenciales y terciarios, y en procesos industriales, presentan un potencial de ahorro energético y reducido impacto ambiental. No obstante su viabilidad económica no es actualmente posible para pequeñas capacidades de potencia, con motivo del alto coste actual de la tecnología respecto a otras alternativas tecnológicas de energía solar, y del controvertido bajo coste actual de los recursos energéticos fósiles convencionales. Por ello, se recomienda aprovechar las economías de escala para mejorar la viabilidad económica de esta tecnología, como por ejemplo mediante su aplicación en procesos industriales de la industria alimentaria, química y papelera.

Este proyecto se enmarca dentro del proyecto europeo "*Development & Implementation of Decentralised Solar Energy-Related Innovative Technologies for Public Buildings in the Mediterranean Basin Countries (DIDSOLIT-PB)",* coordinado por la *Universitat Autònoma de Barcelona* (UAB).

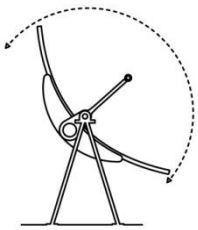
ÍNDICE DE CONTENIDOS

E. FICHAS TÉCNICAS

En este capítulo se presentan las fichas técnicas del fluido térmico y de los principales equipos que conforman la instalación solar térmica experimental de colectores cilindro parabólico, objeto del presente proyecto de final de carrera, e incluye:

- Ficha técnica del colector cilindro parabólico SOLTIGUA PTMx18
- Ficha técnica y de seguridad y salud del fluido de transporte de calor THERMINOL 66
- Ficha técnica del intercambiador de calor PIROBLOC INT-04-10-I
- Ficha técnica de la bomba centrífuga ALLLWEILER NTT 25-160

E1. **Colector cilindro parabólico PTMx**



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PTMx Parabolic Trough Collector – Technical data sheet

Description

PTMx parabolic trough collector is supplied with:

- Selectively coated receiver
- Weather-resistant low iron tempered glass mirrors
- Sun tracking drive and motor
- Hot-dip galvanized metal structure and pylons
- Flanged connecting elements to fixed pipes
- Sensors to measure:
  - Angular position
  - Fluid temperature
  - Wind speed
- Controlling PLC with the following features:
  - Automatic / Manual
  - Web based remote control
  - Safety procedures against:
    - High wind
    - Overheating
    - Lack of flow
  - Stowing procedure in case of bad weather
  - Highly accurate sun tracking according to state-of-the-art astronomic formulas
- Electric panel at 230 VAC

The PTMx collector is CE marked and certified according to EN12975-2.

Performance

Thermal Power $P = \eta \cdot S \cdot DNI$

Efficiency $\eta = K_L \cdot 0.747 - 0.64 \cdot \Delta T/DNI$

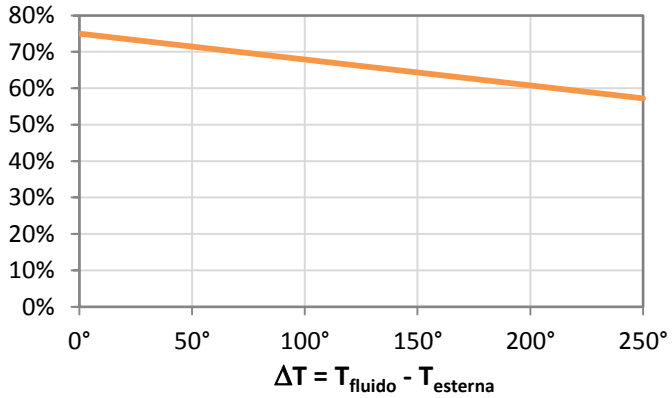
where S = Net Collecting Surface

DNI = Direct Normal Irradiance

K_L = Longitudinal Incident Angle Modifier (IAM)

$\Delta T = (T_{fluid} - T_{external})$

NOTE: Transversal Incident Angle Modifier (K_T) equals 1 for parabolic trough collectors



Efficiency curve in the following conditions: DNI = 900 W/m^2; k_L=1.

Technical data

- Sun Tracking: possible along any orientation
- Working fluid: hot water (up to 110°C) or thermal oil (up to 50°C)
- Maximum working pressure: 8 bar
- External working temperature: -10° - 50°C
- Maximum fluid working temperature: 250°C
- Maximum wind load in full aperture:

type of installation	*PTMx-18, PTMx-24*	*PTMx-30, PTMx-36*
on ground	106 km/h	88 km/h
on roof (h≤10 m)	93 km/h	77 km/h

- Maximum snow load**: 1'500 N/m^2

*: data refer to reference conditions as defined in Italian regulations, with concentrators in full aperture, shape coefficient for mirrors equal to 2, wind speed measured at 10 m above the ground,, in second class of exposition. To be verified according to relevant local regulations.
**: calculation based on Italian regulations. To be verified according to relevant local regulations.

Angle(*)	K_L = Longitudinal IAM			
	PTMx-18	PTMx-24	PTMx-30	PTMx-36
0°	1.000	1.000	1.000	1.000
10°	0.990	0.992	0.994	0.995
20°	0.939	0.944	0.947	0.949
30°	0.847	0.854	0.858	0.861
40°	0.712	0.720	0.725	0.729
50°	0.528	0.537	0.543	0.547
60°	0.286	0.294	0.298	0.301

(*) angle formed between the incident solar beams and the line orthogonal to the aperture plane

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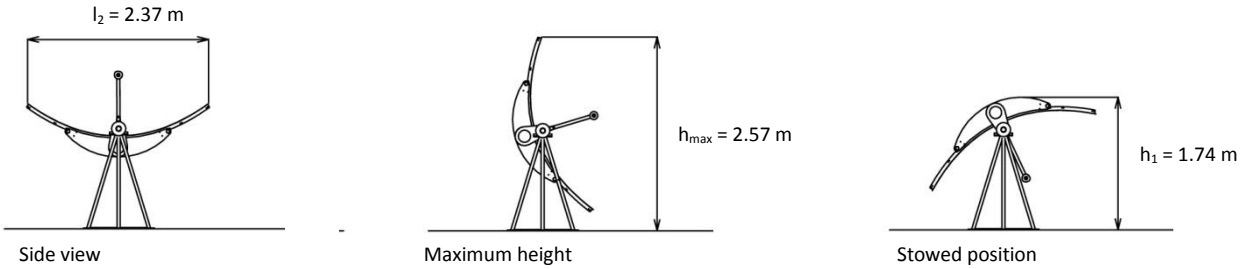
Measures

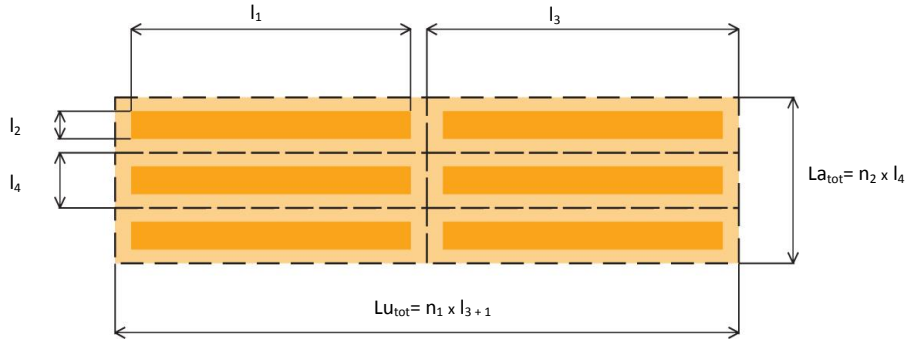
Model	Length (m)	Required length* (m)	Maximum Height (m)	Width (m)	Required width (m)	Solar field			
						Number of collectors	Minimum required surface (m^2)	Net collecting surface (m^2)	Reference capacity** (kW_t)
	l_1	l_3	h	l_2	l_4	n	S_r	S	P_p
PTMx-18	19.70	20.70	2.57	2.37	4.75	1	103	41	23
						4	412	163	93
PTMx-24	26.16	27.16				1	134	54	31
						4	535	218	125
						16	2’140	871	498
						32	4’280	1’741	997
PTMx-30	32.16	33.16				1	162	68	39
						4	649	272	156
						16	2’596	1’088	623
						32	5’192	2’176	1’246
PTMx-36	38.62	39.62				1	193	82	47
						4	772	326	187
						16	3’087	1’306	748
						32	6’174	2’612	1’495

* = Valid for solar field internal collectors. For side collectors add 0.50 m on external sides.
** = corresponding to a specific power of 537 W/mq at the following operating conditions: T_{Outlet} = 200°C; T_{Inlet} = 180°C; $T_{External}$ = 30°C; DNI = 900 W/m^2; θ_L = 0°

Drawings

PTMx





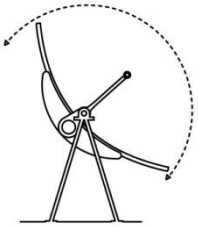
$S_r = Lu_{tot} \times La_{tot}$

$n = n_1 * n_2$

n = number of collectors

n_1 = number of collectors in lenght

n_2 = number of collectors in width



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PTMx Parabolic collector – Data sheet – APPENDIX

Weight

Model	Weight (kg)	Specific weight ($kg/m^2_{aperture}$)
PTMx-18	1’408	34.5
PTMx-24	1’810	33.3
PTMx-30	2’211	32.5
PTMx-36	2’613	32.0

Flow rate

Minimum flow rate to ensure turbolent flow in the receiver tubes (indicative values)

Fluid / Working temperatures	WATER + GLYCOL (40%)	THERMAL OIL		
	80 – 100 °C	**100 – 150 °C**	**151 – 200 °C**	**201 - 250 °C**
All models	20	50	25	20

Q = fluid flow rate, in lt/min
NOTE: values could vary depending on the features of the thermal oil or glycol which is used

Maximum flow rate in the receiver tubes:

For all fluids the maximum flow rate in each collector cannot be above 120 lt/min

Pressure losses as a function of working temperature (indicative values)

Fluid / Working temperatures	WATER + GLYCOL (40%)	THERMAL OIL		
	80 – 100 °C	**100 – 150 °C**	**151 – 200 °C**	**201 - 250 °C**
PTMx-18	$\Delta p = 0.0009 \cdot Q^2 + 0.0033 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0046 \cdot Q$	$\Delta p = 0.0007 \cdot Q^2 + 0.0028 \cdot Q$	$\Delta p = 0.0007 \cdot Q^2 + 0.0014 \cdot Q$
PTMx-24	$\Delta p = 0.0009 \cdot Q^2 + 0.0037 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0048 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0030 \cdot Q$	$\Delta p = 0.0007 \cdot Q^2 + 0.0016 \cdot Q$
PTMx-30	$\Delta p = 0.0009 \cdot Q^2 + 0.0041 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0053 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0035 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0019 \cdot Q$
PTMx-36	$\Delta p = 0.0010 \cdot Q^2 + 0.0046 \cdot Q$	$\Delta p = 0.0009 \cdot Q^2 + 0.0060 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0036 \cdot Q$	$\Delta p = 0.0008 \cdot Q^2 + 0.0022 \cdot Q$

Δp = pressure losses, in m.c..l.
Q = fluid flow rate, in lt/min
NOTE: values could vary depending on the features of the thermal oil or glycol which is used

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E2. **Fluido térmico THERMINOL 66**

THERMINOL® 66

Heat Transfer Fluids By SOLUTIA™

Applied Chemistry, Creative Solutions

High Performance Highly Stable Heat Transfer Fluid

0°C to 345°C

+400°C
+350°C
+300°C
+250°C
+200°C
+150°C
+100°C
+50°C
+0°C
-50°C
-100°C

TM

Therminol 66 is a high performance highly stable synthetic heat transfer fluid offering extended life and very low top-up rates resulting in reduced running costs and minimal downtime for operations at temperatures up to 345°C.

Therminol 66 derives its outstanding performance from the unique stability of the polyphenyl structure.

Intended for use in systems operating at or near atmospheric pressure, Therminol 66 offers potential savings in both capital and operating costs.

Therminol 66 is in use world-wide for many process heating and waste heat recovery applications: resin manufacture, phthalic anhydride distillation, polyester film and fibre production, deodorising fatty acids, phenol production, polyamide polymerisation and extrusion, preheating combustion air in the steel and petrochemical furnaces.

Thermal Stability

The thermal stability of a heat transfer fluid is one of the most important considerations in the selection of a fluid for operation under specific heat transfer conditions. Therminol 66 has made its reputation for its outstanding stability in operation.

Fluid decomposition, both for mineral oil and synthetic hydrocarbon based heat transfer fluids, generally results in the formation of volatile products (low boilers) and polymeric high viscosity fractions (high boilers). The relative proportion of low and high boiler formation and solubility of the high boiling fractions may vary widely, and are critical factors when evaluating fluid performance, predicting top-up costs and the overall risk of deposits or coking.

The chemical composition of Therminol 66 has been carefully selected to minimise the formation of low boilers and eliminate the risk of insoluble high boiler formation and fouling, provided proper attention is given to system design, and operation is within the maximum bulk and film temperatures specified below.

Typical Physical, Chemical and Thermal Properties of Therminol 66

Composition		Hydrogenated terphenyl
Appearance		Clear pale yellow liquid
Max. bulk temperature		345°C
Max. film temperature		375°C
Kinematic viscosity @ 40°C	DIN 51562 - 1	29.64 mm^2/s (cSt)
Density @ 15°C	DIN 51757	1011 kg/m^3
Flash point (Closed cup)	DIN EN 22719	170°C
Fire point	ISO 2592	216°C
Autoignition temperature	DIN 51794	399°C
Pour point	ISO 3016	-32°C
Boiling point @ 1013 mbar		359°C
Coefficient of thermal expansion		0.0009/°C
Moisture content	DIN 51777 - 1	< 150 ppm
Total acidity	DIN 51558 - 1	< 0.02 mg KOH/g
Chlorine content	DIN 51577 - 3	< 10 ppm
Copper corrosion	EN ISO 2160	<< 1a
Average molecular weight		252

Note: Values quoted are typical values obtained in the laboratory from production samples. Other samples might exhibit slightly different data.
Specifications are subject to change. Write to Solutia for current sales specifications.

Properties of Therminol® 66 vs Temperatures

Temperature °C	Density kg/m³	Thermal Conductivity W/m.K	Heat Capacity kJ/kg.K	Viscosity		Vapour pressure (absolute) kPa*
				Dynamic mPa.s	Kinematic mm²/s**	
0	1021.5	0.118	1.495	1324.87	1297.01	-
10	1014.9	0.118	1.529	344.26	339.20	-
20	1008.4	0.118	1.562	123.47	122.45	-
30	1001.8	0.117	1.596	55.60	55.51	-
40	995.2	0.117	1.630	29.50	29.64	-
50	988.6	0.116	1.665	17.64	17.84	-
60	981.9	0.116	1.699	11.53	11.74	-
70	975.2	0.115	1.733	8.06	8.26	0.01
80	968.5	0.115	1.768	5.93	6.12	0.02
90	961.8	0.114	1.803	4.55	4.73	0.03
100	955.0	0.114	1.837	3.60	3.77	0.05
110	948.2	0.113	1.873	2.92	3.08	0.08
120	941.4	0.112	1.908	2.42	2.58	0.12
130	934.5	0.111	1.943	2.05	2.19	0.18
140	927.6	0.111	1.978	1.75	1.89	0.27
150	920.6	0.110	2.014	1.52	1.65	0.40
160	913.6	0.109	2.050	1.34	1.46	0.58
170	906.6	0.108	2.086	1.18	1.30	0.83
180	899.5	0.107	2.122	1.06	1.17	1.17
190	892.3	0.107	2.158	0.95	1.06	1.62
200	885.1	0.106	2.195	0.86	0.97	2.23
210	877.8	0.105	2.231	0.78	0.89	3.02
220	870.4	0.104	2.268	0.72	0.82	4.06
230	863.0	0.103	2.305	0.66	0.77	5.39
240	855.5	0.102	2.342	0.61	0.71	7.10
250	847.9	0.100	2.379	0.57	0.67	9.25
260	840.3	0.099	2.417	0.53	0.63	11.95
270	832.5	0.098	2.455	0.49	0.59	15.31
280	824.6	0.097	2.492	0.46	0.56	19.46
290	816.6	0.096	2.531	0.44	0.54	24.55
300	808.5	0.095	2.569	0.41	0.51	30.73
310	800.3	0.093	2.608	0.39	0.49	38.22
320	792.0	0.092	2.647	0.37	0.47	47.20
330	783.5	0.091	2.686	0.35	0.45	57.94
340	774.8	0.089	2.726	0.34	0.43	70.68
350	765.9	0.088	2.766	0.32	0.42	85.74
360	756.9	0.086	2.806	0.31	0.41	103.42
370	747.7	0.085	2.847	0.30	0.39	124.09
380	738.2	0.084	2.889	0.28	0.38	148.13

* 1 bar = 100 kPa - ** 1 mm²/s = 1 cSt

Note: Values quoted are typical values obtained in the laboratory from production samples. Other samples might exhibit slightly different data. Specifications are subject to change. Write to Solutia for current sales specifications.

Physical Property Formulae

Density (kg/m³) = -0.614254 * T (°C) - 0.000321 * T² (°C) + 1020.62

Heat capacity (kJ/kg.K) = 0.003313 * T (°C) + 0.0000008970785 * T² (°C) + 1.496005

Thermal Conductivity (W/m.K) = -0.000033 * T (°C) - 0.00000015 * T² (°C) + 0.118294

Kinematic Viscosity (mm²/s) = $e^{\left(\frac{586.375}{T(°C)+62.5} - 2.2809\right)}$

Vapour Pressure (kPa) = $e^{\left(\frac{-9094.51}{T(°C)+340} + 17.6371\right)}$

The Therminol® Range

Therminol 66 is one of the Solutia synthetic heat transfer fluids covering an operating range from -85°C to 400°C, suitable for most process heating and cooling or heat recovery applications, and capable of operation at or near atmospheric pressure within their recommended operating temperature range.

As a user's process temperature demands change there is always a Therminol fluid capable of meeting the new requirements. In addition, the Therminol fluids are often interchangeable allowing conversion by a simple top-up procedure where this is preferred.

Solutia also has a standard DP-DP0 eutectic, Therminol VP1 .

Quality Control Certification

Solutia has obtained **ISO 9002/BS 5750** quality control certification (1/6/1989) reference n° **FM 1970** for Therminol 66. This registration means that plant procedures, quality control systems, material sampling, product storage, handling, packaging, shipping, product literature and characteristic data, record keeping and other company procedures are in line with the quality requirements of the ISO 9002 standards and its other national equivalents.
This is your quality assurance.

Health, Safety and Environmental Information

Please contact us for the Material Safety Data Sheet, or if any other information concerning health, safety and environmental issues is required during the filling or operation of your heat transfer system with this product.

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Please contact us for more information :

GROUP PROVOC T.B.S 10-7 (12/98) E

EASTMAN

Material Safety Data Sheet

Issuing date 03-Jul-2013 **Revision date** 03-Jul-2013 **Version** 7

SECTION 1: Identification of the substance/mixture and of the company/undertaking

Product name **THERMINOL® 66**

Product code **90025**

Recommended Use Heat transfer fluids

Manufacturer

Solutia Inc.
A subsidiary of Eastman Chemical Company
575 Maryville Centre Drive
St. Louis, Missouri 63141 U.S.A.
Telephone: +1-314-674-6661

Emergency Phone Number Chemtrec: 1-800-424-9300 - Direct Dial:1-703-527-3887

SECTION 2: Hazards identification

EMERGENCY OVERVIEW

May cause slight eye irritation
Substance may cause slight skin irritation

Appearance Clear **Physical State** Liquid **Odor** Characteristic

Potential health effects

Acute toxicity

Eyes May cause slight irritation. Not expected to produce significant adverse health effects when recommended use instructions are followed.

Skin May cause slight irritation. Patch test on human volunteers did not demonstrate sensitization properties. Not expected to produce significant adverse health effects when recommended use instructions are followed.

Inhalation Elevated processing temperatures may cause release of vapors which are irritating if inhaled.

Ingestion Not expected to produce significant adverse health effects when recommended use instructions are followed.

Chronic effects No known effect.

Aggravated Medical Conditions Preexisting eye disorders. Skin disorders.

Environmental hazard May cause long lasting harmful effects to aquatic life. See Section 12 for additional Ecological Information.

SECTION 3: Composition/information on ingredients

Chemical name	CAS-No	Weight %
Terphenyl, hydrogenated	61788-32-7	74 - 87
Polyphenyls, quater- and higher, partially hydrogenated	68956-74-1	10 - 18
Terphenyl	26140-60-3	3 - 8

SECTION 4: First aid measures

General advice	When symptoms persist or in all cases of doubt seek medical advice. If unconscious, place in recovery position and get medical attention immediately. Show this material safety data sheet to the doctor in attendance.
Eye contact	Immediately flush with plenty of water. After initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Get medical attention immediately if symptoms occur.
Skin contact	Wash off immediately with soap and plenty of water. Remove contaminated clothing and shoes. Get medical attention if irritation develops and persists. In case of burns, immediately cool affected skin for as long as possible with cold water. For severe burns, immediate medical attention is required. Wash contaminated clothing before reuse. Discard contaminated shoes.
Inhalation	Remove to fresh air. If not breathing give artificial respiration. If breathing is difficult, give oxygen. Call a physician. Keep victim warm and quiet. Loosen tight clothing such as a collar, tie, belt or waistband. Maintain an open airway. Persons who have inhaled vapors or smoke fumes have to be put under medical observation for at least 48 hours, due to the delayed appearance of poisoning.
Ingestion	If swallowed, rinse mouth with water (only if the person is conscious). Remove victim to fresh air and keep at rest in a position comfortable for breathing. Loosen tight clothing such as a collar, tie, belt or waistband. Never give anything by mouth to an unconscious person. Do NOT induce vomiting unless directed to do so by a physician. If vomiting occurs spontaneously, keep head below hips to prevent aspiration. Maintain an open airway. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician immediately.
Notes to physician	Treat symptomatically. Contact with hot material: Treat for thermal burns. Persons who have inhaled vapors or smoke fumes have to be put under medical observation for at least 48 hours, due to the delayed appearance of poisoning.

SECTION 5: Firefighting measures

Flammable properties	This product is not classified as a fire-resistant heat transfer fluid. Precautions to avoid sources of ignitions should be taken.
Flash point	170 °C / 338 °F
Method	DIN EN 22719, Pensky-Martens. Closed cup
Suitable extinguishing media	Water spray, Foam, Dry powder, Carbon dioxide (CO_2)
Explosion Data	
Sensitivity to Mechanical Impact	None
Sensitivity to static discharge	None
Protective equipment and precautions for firefighters	As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear.

SECTION 6: Accidental release measures

Personal precautions	No action shall be taken involving any personal risk or without suitable training. Do not touch or walk through spilled material. Avoid contact with skin, eyes and clothing. Wear personal protective equipment.
Environmental precautions	Prevent further leakage or spillage if safe to do so. Clean up spill immediately. Prevent product and washings from entering drains, sewers or surface water due to high toxicity to aquatic organisms.

Methods for containment Prevent further leakage or spillage if safe to do so. Dike to collect large liquid spills.

Methods for cleaning up Soak up with inert absorbent material. Collect in closed and suitable containers for disposal.

SECTION 7: Handling and storage

Advice on safe handling Avoid contact with skin, eyes and clothing. Use in well ventilated areas. Wear personal protective equipment. Do not eat, drink or smoke when using this product. Handle in accordance with good industrial hygiene and safety practice. This product is not classified as a fire-resistant heat transfer fluid. Precautions to avoid sources of ignitions should be taken.

Technical measures/Storage conditions Keep containers tightly closed in a dry, cool and well-ventilated place. Keep away from direct sunlight. Keep away from contact with oxidizing materials. Keep in properly labeled containers. Use appropriate containment to avoid environmental contamination. Containers that have been opened must be carefully resealed and kept upright to prevent leakage. Store in accordance with local regulations.

SECTION 8: Exposure controls/personal protection

Exposure Guidelines .

Chemical name	ACGIH TLV	OSHA PEL	NIOSH IDLH
Terphenyl, hydrogenated	TWA: 0.5 ppm non-irradiated	TWA: 0.5 ppm TWA: 5 mg/m³	TWA: 0.5 ppm TWA: 5 mg/m³
Terphenyl	Ceiling: 5 mg/m³	Ceiling: 1 ppm Ceiling: 9 mg/m³	IDLH: 500 mg/m³

Engineering measures Good general ventilation should be sufficient to control worker exposure to airborne contaminants. Apply technical measures to comply with the occupational exposure limits. If this product contains ingredients with exposure limits, personal, workplace atmosphere or biological monitoring may be required to determine the effectiveness of the ventilation or other control measures and/or the necessity to use respiratory protective equipment.

Personal protective equipment

Eye/face protection Goggles Have eye-wash facilities immediately available

Skin and body protection Wear protective gloves and additional protective clothing as necessary to prevent exposures.

Respiratory protection If exposure limits are exceeded or irritation is experienced, NIOSH/MSHA approved respiratory protection should be worn

Hygiene measures Handle in accordance with good industrial hygiene and safety practice.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical State	Liquid
Appearance	Clear
Odor	Characteristic
Color	Colorless to light yellow
Odor threshold	No information available

Property	**Values**	**Remarks • Methods**
pH	No information available	
Melting point/freezing point	< -24 °C / -11 °F	Pour point: 1013 hPa
Boiling point/boiling range	342 °C / 648 °F	1013 hPa
Flash point	170 °C / 338 °F	DIN EN 22719, Pensky-Martens, Closed cup
	184 °C / 363 °F	ASTM D-92, Cleveland Open Cup
Evaporation Rate	No information available	
Specific gravity	1.013	20 °C
Flammability (solid, gas)		
Flammability Limits in Air		
Upper flammability limit	No information available	
Lower flammability limit	No information available	
Vapor pressure	0.00174 hPa	20 °C
Vapor density	No information available	
Water solubility	0.061 mg/l	20 °C
Solubility in other solvents	No information available	
Partition coefficient: n-octanol/water	> 3160000	
Autoignition temperature	374 °C / 705 °F	1013 hPa ASTM E-659
Decomposition temperature	No information available	
Viscosity, kinematic	133 mm²/s	20 °C
	29.6 mm²/s	40 °C
	3.8 mm²/s	100 °C
Viscosity, dynamic	No information available	
Explosive properties	Not explosive	
Oxidizing properties	Not oxidizing	

9.2 Other Information

Density	1005 kg/m³	25 °C

SECTION 10: Stability and reactivity

Stability	Stable under recommended storage and handling conditions (see section 7).
Incompatible products	Strong oxidizing agents.
Conditions to avoid	This product is not classified as a fire-resistant heat transfer fluid. Precautions to avoid sources of ignitions should be taken.
Hazardous decomposition products	None known based on information supplied.
Hazardous polymerization	Hazardous polymerization does not occur.

SECTION 11: Toxicological information

Acute toxicity

Product Information Product does not present an acute toxicity hazard based on known or supplied information.

Inhalation Elevated processing temperatures may cause release of vapors which are irritating if inhaled.

Eyes May cause slight irritation. Not expected to produce significant adverse health effects when recommended use instructions are followed.

Skin May cause slight irritation. Patch test on human volunteers did not demonstrate sensitization properties. Not expected to produce significant adverse health effects when recommended use instructions are followed.

Ingestion Not expected to produce significant adverse health effects when recommended use instructions are followed.

Chemical name	LD50 Oral	LD50 Dermal	LC50 Inhalation
Terphenyl, hydrogenated	> 10000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 4.7 mg/l (Rat) 4 h
Terphenyl	> 2000 mg/kg (Rat)	> 2000 mg/kg (Rabbit)	> 3.8 mg/l (Rat)

Chronic Toxicity

Chronic Toxicity No known effect.

Carcinogenicity This product does not contain any carcinogens or potential carcinogens as listed by OSHA, IARC or NTP.

Sensitization Patch test on human volunteers did not demonstrate sensitization properties.

Germ cell mutagenicity Not mutagenic (in vitro, in vivo).

Developmental Toxicity OECD Test No. 414: Prenatal Development Toxicity Study: Negative.

Target organ effects None known.

SECTION 12: Ecological information

Acute aquatic toxicity

Product Information

Property	Result	Species
96-hour LC50 - Fish	No data available	No information available
48-hour EC50 - Aquatic invertebrates	No data available	No information available
72-hour EC50 - Algae/aquatic plants	No data available	No information available

Component Information

Chemical name	Toxicity to algae	Toxicity to fish	Toxicity to daphnia and other aquatic invertebrates
Terphenyl, hydrogenated	56 mg/l	> 1.000 mg/l	> 1.34 mg/l
Terphenyl	0.103 mg/l	27 mg/l	22 µg/l

May cause long lasting harmful effects to aquatic life.

Ecotoxicity

Chemical name	log Pow
Terphenyl, hydrogenated	6.5
Terphenyl	5.09

SECTION 13: Disposal considerations

Waste disposal methods

This material when discarded may be a hazardous waste as that term is defined by the Resource Conservation and Recovery Act (RCRA), 40 CFR 261.24, due to its toxicity characteristic. This material should be analyzed in accordance with Method 1311 for the compound D018 BENZENE. Consult 40 CFR 268.40 or appropriate local regulations for concentration based standards.

Contaminated packaging

Empty containers should be taken to an approved waste handling site for recycling or disposal.

Other Information

This product meets the criteria for synthetic used oil under the U.S. EPA Standards for the Management of Used Oil (40 CFR 279). Those standards govern recycling and disposal in lieu of 40 CFR 260 -272 of the Federal hazardous waste program in states that have adopted these used oil regulations. Consult your attorney or appropriate regulatory official to be sure these standards have been adopted in your state. Recycle or burn in accordance with the applicable standards. Solutia operates a used fluid return program for certain fluids under these used oil standards. Contact your Sales Representative for details. This product should not be dumped, spilled, rinsed or washed into sewers or public waterways.

SECTION 14: Transport information

DOT Not regulated

IMDG Not regulated

IATA Not regulated

TDG Not regulated

SECTION 15: Regulatory information

U.S. Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372

SARA 311/312 Hazard Categories

Acute Health Hazard	no
Chronic Health Hazard	no
Fire Hazard	no
Sudden release of pressure hazard	no
Reactive Hazard	no

Clean Water Act

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

CERCLA
This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

U.S. State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals.

U.S. State Right-to-Know Regulations

Chemical name	Massachusetts	New Jersey	Pennsylvania	Illinois	Rhode Island
Terphenyl, hydrogenated	X	X	X		
Terphenyl	X	X	X		

International Regulations

Chemical name	Carcinogen Status	Exposure Limits
Terphenyl, hydrogenated		Mexico: TWA 0.5 ppm Mexico: TWA 5 mg/m^3
Terphenyl		Mexico: Ceiling 0.5 ppm

Canada

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR

WHMIS Hazard Class
Non-controlled

International Inventories

TSCA (US)	Complies
DSL/NDSL (Canada)	Complies
EINECS/ELINCS (EU)	Complies
ENCS (Japan)	-
IECSC (China)	Complies
KECL (Korea)	Complies
PICCS (Philippines)	Complies
AICS (Australia)	Complies

SECTION 16: Other information

NFPA	**Health hazard** 1	**Flammability** 1	**Stability** 0
HMIS	**Health hazard** 1	**Flammability** 1	**Physical hazard** 0

Prepared By

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Revision Note	New MSDS format; (M)SDS sections updated: All.

Disclaimer

The information provided in this Material Safety Data Sheet is correct to the best of our knowledge, information and belief at the date of its publication. The information given is designed only as a guidance for safe handling, use, processing, storage, transportation, disposal and release and is not to be considered a warranty or quality specification. The information relates only to the specific material designated and may not be valid for such material used in combination with any other materials or in any process, unless specified in the text.

End of Material Safety Data Sheet

E3. Intercambiador de calor PIROBLOC

PIROBLOC
GENERADORES DE FLUIDO TERMICO
CALDERAS DE VAPOR. INGENIERIA

INTERCAMBIADORES

LÍNEA INT

INTERCAMBIADOR DE CALOR

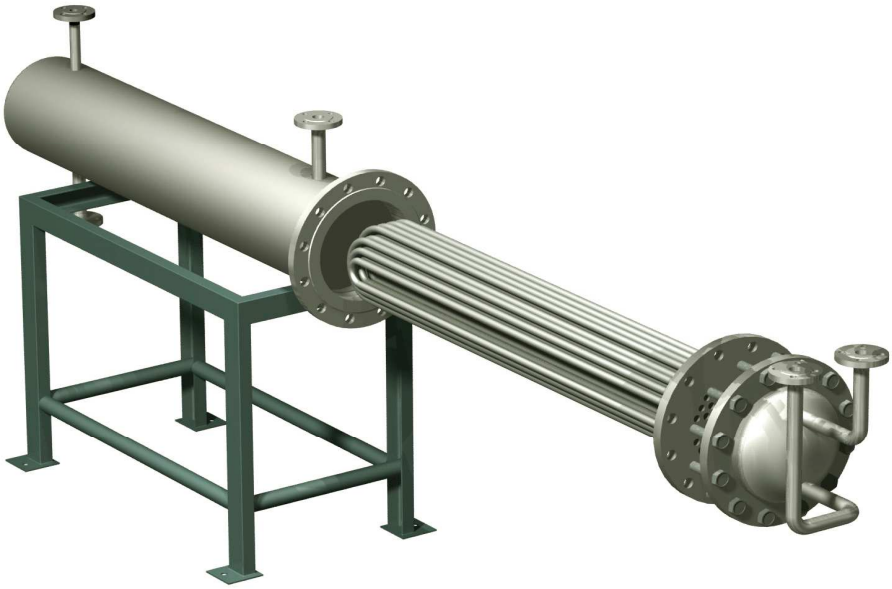
Modelos especiales para:

· Aplicaciones aceite térmico-vapor
· Aceite térmico-agua caliente
· Aceite térmico-aire
· Aceite térmico-aceite vegetal
· Vapor - agua caliente
· Otros fluidos primarios y secundarios
· Otros materiales
· Otras presiones diseño

Características:

· Códigos de diseño: AD-MERKBLÄTTER, TEMA
· Marcado CE
· Circuito primario y secundario
· Envolvente: chapa de acero UNE-36011
· Bridas: PN16 y PN25
· Fondos toriesféricos según UNE-9201
· Galvanizado según UNE-37501
· Serpentines mediante tubo expansionado
· Fabricado según directiva 97/23/CE

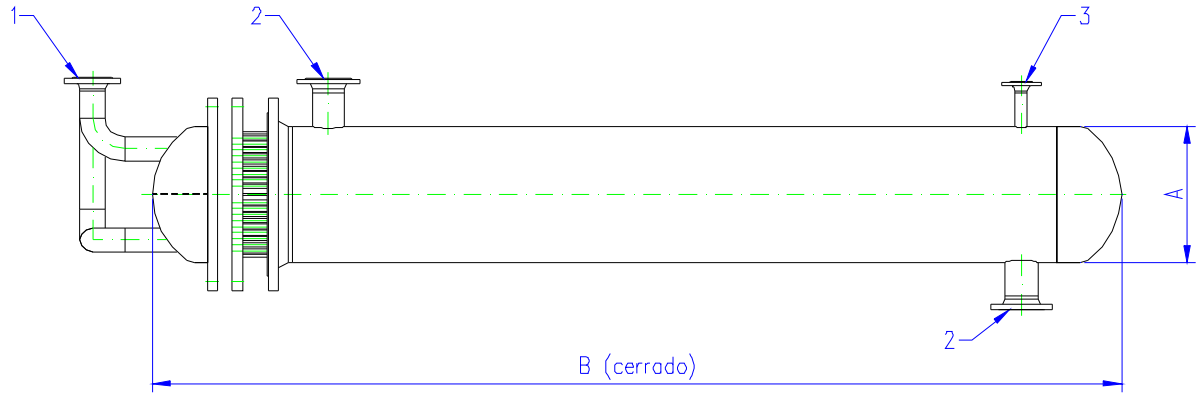
Esquema intercambiador



	Recinto I	Recinto II
Denominación	Haz tubular	Carcasa
Fluido contenido	Fluido térmico	Fluido (*)
Presión diseño (bar)	6	6
Presión prueba (bar)	9	9
Temperatura diseño (ºC)	300	300

(*) En el recinto II, el fluido contenido variará según la aplicación a que se destine el intercambiador de calor, pudiendo ser agua o aceite vegetal.

Esquema general intercambiador



MODELO INTERCAMB. HIERRO	Dimensiones (mm)		Conexiones			Superficie intercambio (m²)
	A	B	1	2	3	
INT-004-10-F	273 – DN250	1700	DN25	DN25	DN20	4
INT-008-10-F	273 – DN250	3000	DN32	DN40	DN20	8
INT-012-12-F	323.9 – DN300	3100	DN40	DN50	DN20	12
INT-016-14-F	355.6 – DN350	3100	DN50	DN50	DN20	16
INT-019-16-F	406.4 – DN400	3200	DN50	DN65	DN25	19
INT-024-16-F	406.4 – DN400	3300	DN65	DN65	DN25	24
INT-024-20-F	508 – DN500	3300	DN65	DN65	DN25	24
INT-036-20-F	508 – DN500	3300	DN65	DN80	DN32	36
INT-038-20-F	508 – DN500	3300	DN80	DN80	DN32	38

MODELO INTERCAMB. INOX.	Dimensiones (mm)		Conexiones			Superficie intercambio (m²)
	A	B	1	2	3	
INT-009-12-I	323.9 - DN300	3200	DN65	DN65	DN25	9
INT-013-14-I	355.6 – DN350	3200	DN80	DN80	DN25	13
INT-016-20-I	508 – DN500	1100	DN100	DN100	DN25	16
INT-029-20-I	508 – DN500	3300	DN100	DN100	DN40	29
INT-038-20-I	508 – DN500	3400	DN100	DN100	DN40	38

*El fabricante se reserva el derecho de modificar el equipo con el fin de mejorarlo.

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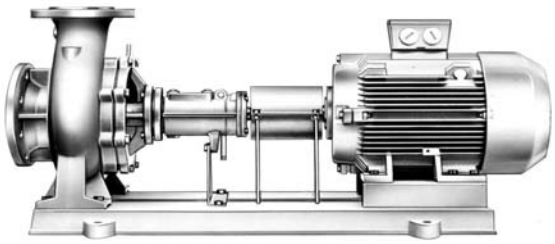
Tel. 00 34 937 189 064 – Fax 00 34 902 908 812

E4. **Bomba centrífuga ALLWEILER NTT**

Volute Casing Centrifugal Pumps PN 16 for Heat Transfer Oils up to 350°C Series NTT

Pump dimensions acc. to DIN EN 733 with additional sizes

ATEX 100 a



Application

For handling organic heat-transfer oils in heat transfer plants (DIN 4754). The fluids pumped must not contain any abrasive particles nor chemically attack the pump materials.

Main Fields of application

Chemical and pharmaceutical industry:
Heating and drying plants, stirring apparatuses, autoclaves, reaction tanks, in plants for the production of synthetic fibres, plastics, lacquer raw materials, in mixing and storage facilities for viscous media.

Food industry:
Heating of baking and roasting ovens, plants for the production of fatty acids, edible oils, glycerine, dry pastes.

Textile, leather and paper industry:
Heating of calendars, drying chambers, rolls, drying cylinders.

Rubber and plastic industry:
Heating of presses, automatic injection, moulding machines, calendars, fusion kettles.

Paint and lacquer industry:
Heating of agitators and mixing vessels.

Tar and bitumen-processing industry:
Heating of storage tanks, tankers, for heating up heavy oil, in asphalt processing and roofing-felt production.

Mineral-oil industry:
Heating of transportation means, pipes and storage installations, for pre-heating of oils, in the bitumen production.

Laundries:
Heating of dryers, hot mangles, automatic ironing machines.

Additionally, for the most varied fields of application in the metal-working industry, electrical-engineering industry, wood industry, building industry.

Type and series construction

Horizontal, single- and two-stage, single-flow volute casing centrifugal pumps with axial inlet. The pump dimensions are according to DIN EN 733. The series contains additional sizes with dimensions exceeding to the standard.

Series design according to unit assembly system. Shaft bearing in a bearing bracket equipped with a support foot.

Volute casing with cast-on feet.

Sizes NTT 2/25-200/01, 2/32-200/01, 2/40-200/01 and 2/50-200/01 are double-stage, but in their outer dimensions, they correspond to the respective single-stage sizes. Owing to the two-stage design, relatively small delivery flows are achieved with the great delivery heads, good efficiencies and low NPSH values.

Branch position/Flanges

Suction branch:	axial
Delivery branch:	radially upwards
Flanges:	according to EN 1092-2, PN16

Delivery

With the sizes according to DIN EN 733, the delivery considerably exceeds the standard nominal capacity.

With further sizes, the performance range was extended in both directions, viz greater and smaller deliveries, for the economic operation of smaller heat-transfer plants.

Shaft sealing

By means of uncooled, maintenance-free mechanical seal of the unbalanced type.

A safety stuffing box with a following throttling area is arranged in front of the mechanical seal.

Even in case of failure of the mechanical seal, these additional safety elements prevent seepage from the emerging in a hazardous quantity and manner. The requirements according to DIN 4754 are thus exceeded.

It is ensured that any heat-transfer seepages emerging from the shaft sealing are safely drained through leakage outlet LO, and completely collected.

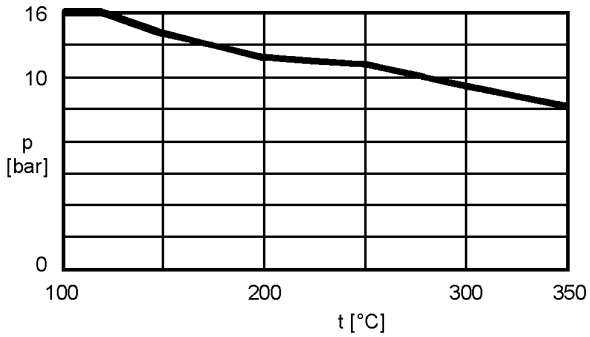
Owing to a special design of the built-in unit, the temperature is reduced to such an extent that proper functioning of the bearing and shaft sealing is ensured.

Shaft sealing			
Abbreviation	Material design		Material key DIN EN 12 756
U5A	Rotating seal ring	Hard carbon, antimony impregnated	A
	Stationary seal ring	SSiC, silicon carbide	Q
	O-ring	Caoutchouc fluoride (FPM)	V
	Spring	CrNiMo steel	G
	Other construction parts	CrNiMo steel	G

Performance data

Q	up to 1450 m^3/h	p_s	up to 7 bar
H	up to 155 m	p_d	16 bar ①
t	up to 350 °C		

① p_d depends on the temperature of the fluid pumped. Please refer to the diagram on page 2.



Inlet pressure (p_s) plus maximum delivery head must not exceed the curve values for the final pump pressure (p_d).

Application limits

Ambient temperature: min. -10 °C
max. +40 °C

Bearing and lubrication

By means of two grooved ball bearings C4 DIN 625 with the one on the pump side being lubricated by the fluid to be pumped, the one on the driving side by special grease.

Viscosity limit

The viscosity of the pumped fluid must be at least 3 cSt at 120 °C (temperature at the pump-sided bearing).

Dismantling of the insert unit

When using a shaft coupling with spacer, the insert unit may be dismantled towards the motor side while the volute casing and motor may remain on the base plate and the pipe lines at the volute casing.

Combination of components

The table on page 3 shows the combination possibilities of components of all NTT sizes.

The unit assembly system allows a simplified spare parts management.

Connections

The following connections are always provided:

FD Draining

FF Filling

LO Leakage outlet *

V Venting

* According to DIN 4754 for the safe draining of the heat transfer seepage quantities emerging from the shaft sealing.

Shaft coupling and accidental contact protection

Flexible shaft coupling according to DIN 740 without or with spacer. A coupling guard as protection against accidental contact according to DIN 31001 is supplied as soon as the scope of supply includes pump, base plate and shaft coupling.

Two coupling types are available: single flexible and double cardanic coupling.

The pump sizes with bearing bracket size 470, nominal impeller diameter 315 and 400 and the pump sizes with bearing bracket sizes 530 and 650 will be equipped with double cardanic couplings.

Base plates

Two base plate designs are available: base plates of steel, U-beam and base plates with drip channel of cast iron or steel, welded (material design depending on size).

All coupling types and base plate designs can be combined with each other.

With our interactive system ALL2CAD, you will get the aggregate dimensions.

Drive

Surface-cooled, three-phase squirrel cage induction motors, IM B3 type of construction, enclosure IP 55 according to IEC Standard, class F insulation, capacities and main dimensions according to DIN 42673.

Materials

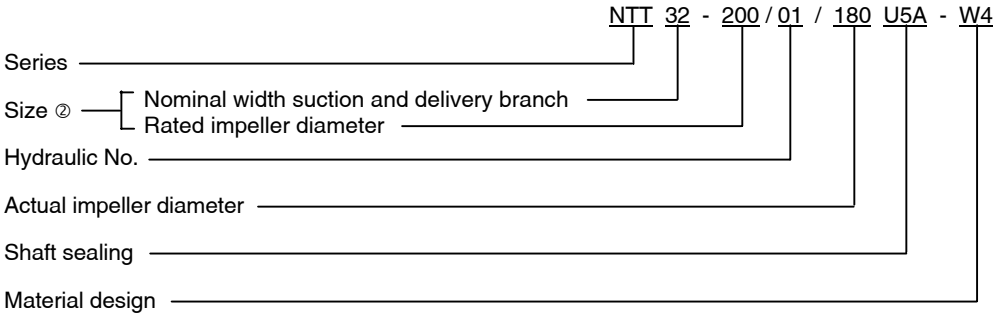
Denomination	Part No.		Material design
	single-stage	two-stage	W 4
Volute casing	102.01	102.01	EN-GJS-400-15 (GGG-40)
Impeller	230.01	-	EN-GJL-200 (GG-20)
Impeller 1st stage	-	230.02	EN-GJL-200 (GG-20)
Impeller 2nd stage	-	230.03	EN-GJL-200 (GG-20)
Diffuser	-	171.01	EN-GJL-200 (GG-20)
Stage casing	-	108.01	EN-GJL-250 (GG-25)
Casing cover	161.01	-	EN-GJS-400-15 (GGG-40)
Casing cover	-	161.02	EN-GJS-400-15 (GGG-40)
Shaft	210.01	210.02	1.7139 (16MnCrS5)
Bearing bracket	330.01	330.01	EN-GJL-250 (GG-25)
Bearing cover	360.02	360.02	EN-GJL-250 (GG-25)
Intermediate ring	509.01	-	EN-GJS-400-15 (GGG-40)
Impeller nut	922.01	922.01	5
Spring washer	936.01	936.01	Spring steel
Spring disk	934.01	-	Spring steel
Key	940.01	940.03	St 50-1 K
Key	940.02	940.02	St 50-1 K

Explosion protection

The pump fulfils the requirements according to EC Explosion Protection Directive 94/9EG (ATEX 100a) for equipment and equipment group II, category 2 G. Categorisation into temperature classes according to EN 13463-1 depends on the temperature of the pumped medium. The max. permissible temperature of the pumped medium for the respective temperature classes are shown in the order specific data sheet.

Note: In case of the operation of a category 2 pump, the unacceptable heating of the pump surfaces caused by a possible operational fault must be prevented by a control mechanism. In case of an operation with know parameters (Q, H, υ, ρ = const.), a pump performance controller can be supplied with the pump to detect any operational faults.

Abbreviation system



The abbreviation is displayed on the nameplate. With the two-stage sizes, the actual impeller diameter relates to the second stage.

② With the two-stage sizes, the number of stages is placed with an oblique stroke in front of the nominal width of suction branch, e.g. 2/32-200/01/...

Combination of components

The following table shows the combination possibilities of components or spare parts of the NTT sizes.

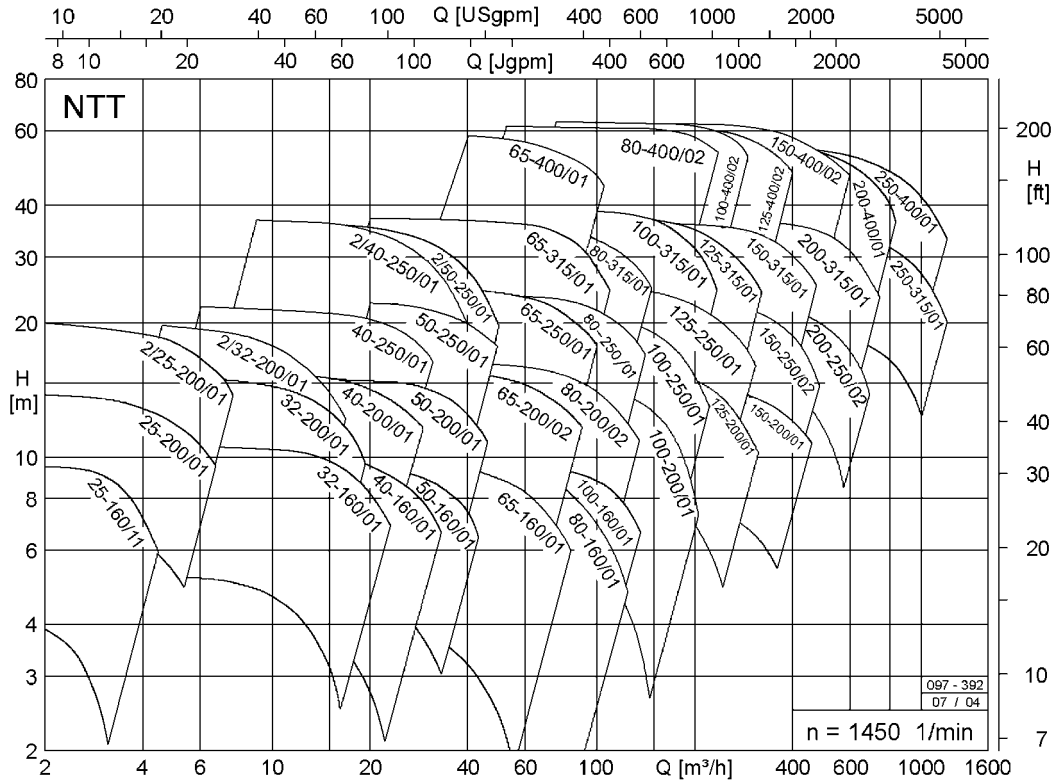
Bearing bracket size	Pump size	Volute casing	Impeller	Impeller 1st stage	Impeller 2nd stage	Diffuser	Stage casing	Intermediate ring	Casing cover	Bearing bracket	Shaft	Support foot
360	25-160/11 ③	1	1	-	-	-	-	-	1	1	1	1
	25-200/01 ③	2	2									2
	2/25-200/01 ③		-	1	1	1	1		2		2	
	32-160/01	3	3	-	-	-	-		1		1	1
	32-200/01	4	4									2
	2/32-200/01 ③		-	1	1	1	1		2		2	
	40-160/01	5	5	-	-	-	-		1		1	1
	40-200/01	6	6									2
	40-250/01	7	7					1				3
	2/40-250/01 ③		-	2	2	2	2	-	3		2	
	50-160/01	8	8	-	-	-	-		1		1	2
	50-200/01	9	9									
	50-250/01	10	10					1				3
	2/50-250/01 ③		-	3	2	2	2	-	3		2	
	65-160/01	11	11	-	-	-	-	-	1		1	2
	65-200/02	12	12					1				3
	80-160/01 ③	13	13					-				
	100-160/01 ③	14	14									4
470	65-250/01	15	15	-	-	-	-	-	4	2	3	5
	65-315/01	16	16					2				6
	65-400/01 ③	17	17					3				7
	80-200/02	18	18					-				8
	80-250/01	19	19									5
	80-315/01	20	20					2				7
	100-200/01	21	21					-				5
	100-250/01	22	22									6
	100-315/01	23	23					2				7
	125-200/01 ③	24	24					-				
	125-250/01	25	25									
	150-200/01 ③	26	26									8
530	80-400/02 ③	27	27	-	-	-	-	4	5	3	4	9
	100-400/02	28	28									
	125-315/01	29	29					-				
	125-400/02	30	30					4				10
	150-250/02 ③	31	31					-	6			9
	150-315/01	32	32						5			
	150-400/02	33	33					4				10
	200-250/02 ③	34	34					-	6			11
650	200-315/01 ③	35	35	-	-	-	-	-	7	4	5	12
	200-400/01 ③	36	36									
	250-315/01 ③	37	37									13
	250-400/01 ③	38	38									

③ Additional size

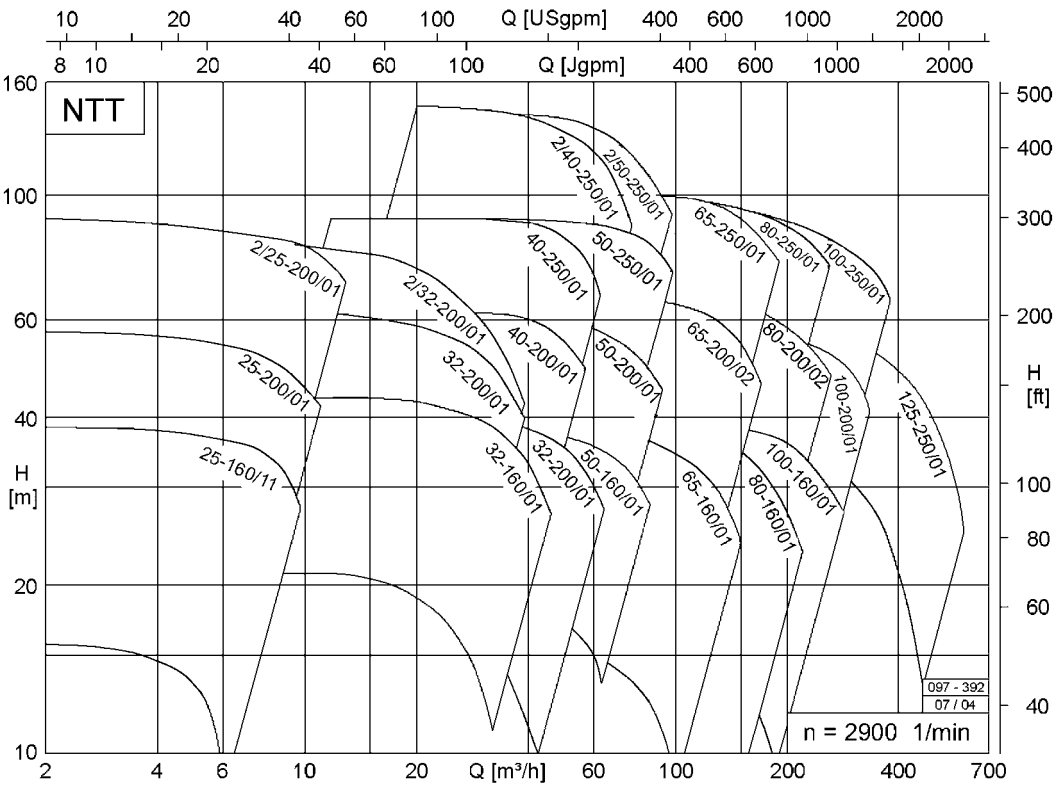
Within a vertical column, parts with identical numbers are interchangeable.

Performance graphs

n = 1450 1/min

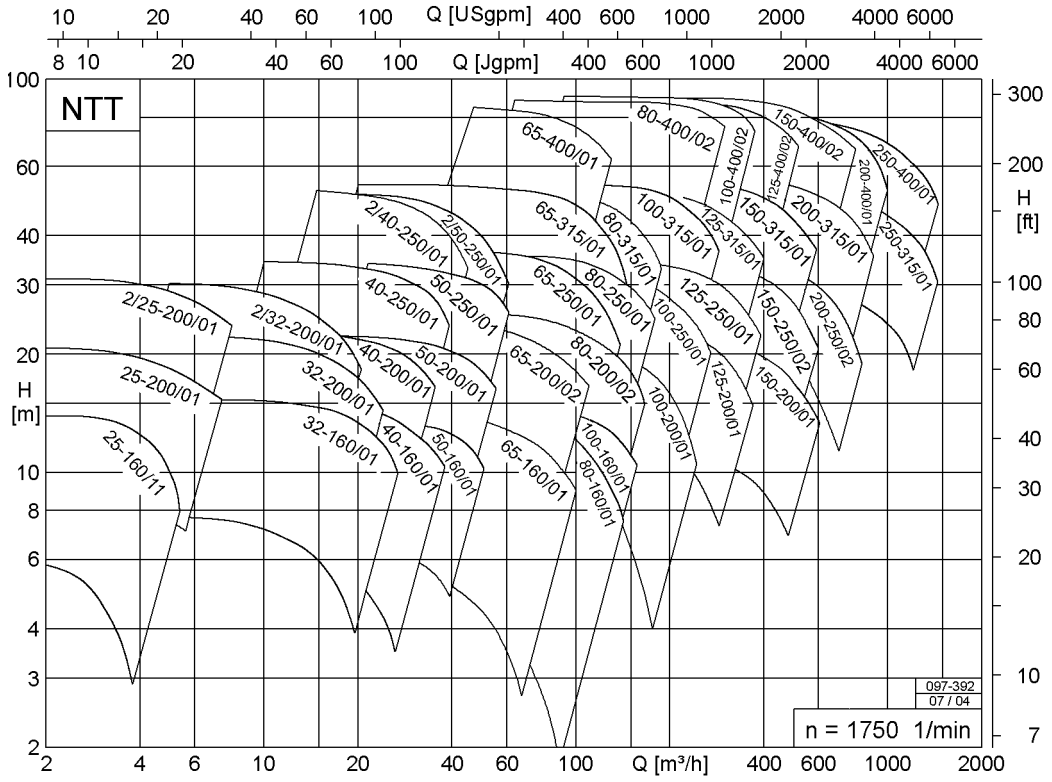


n = 2900 1/min

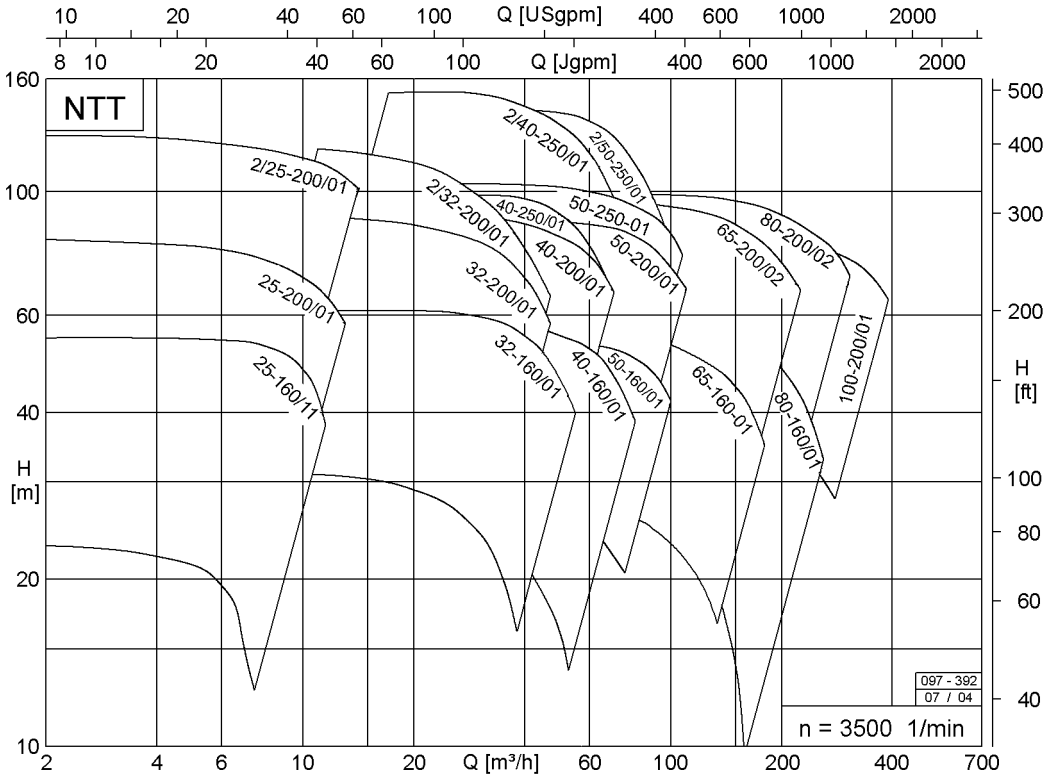


For exact performance data, please refer to the individual characteristics.

n = 1750 1/min



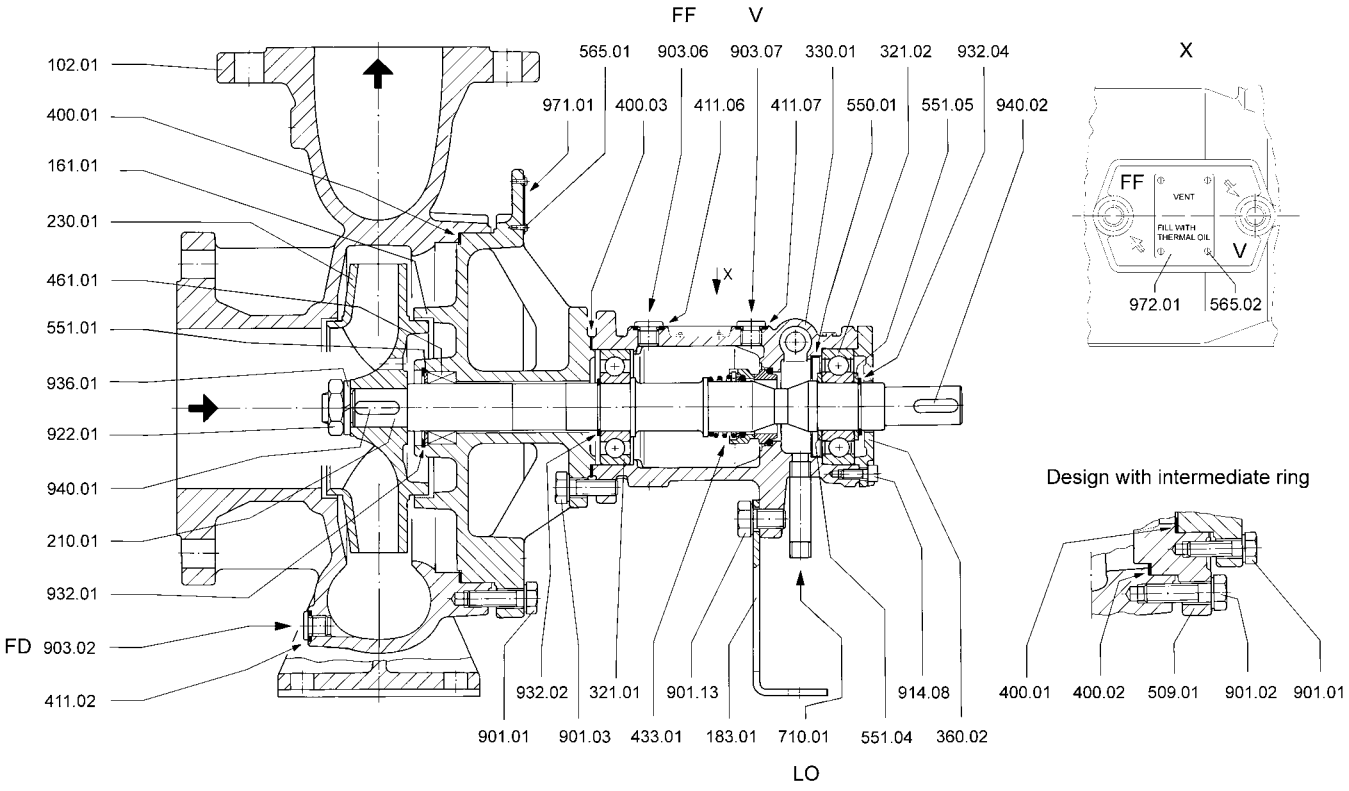
n = 3500 1/min



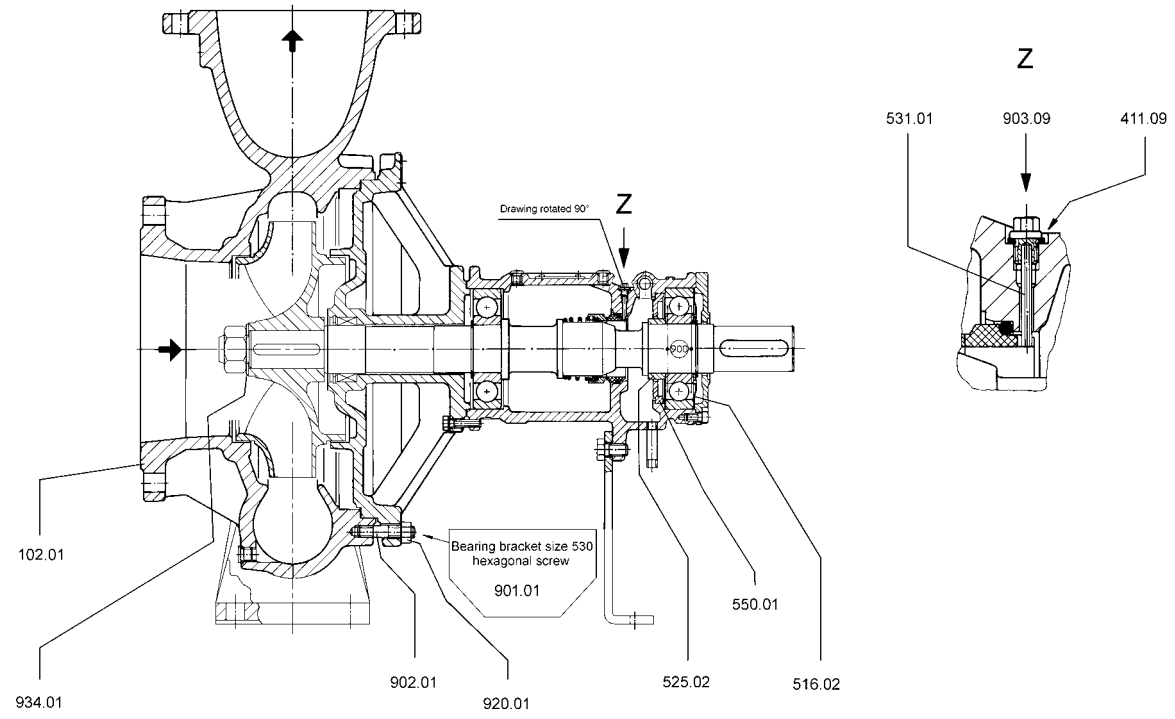
For exact performance data, please refer to the individual characteristics.

Sectional drawing for single-stage sizes

Sizes at bearing bracket sizes 360 and 470



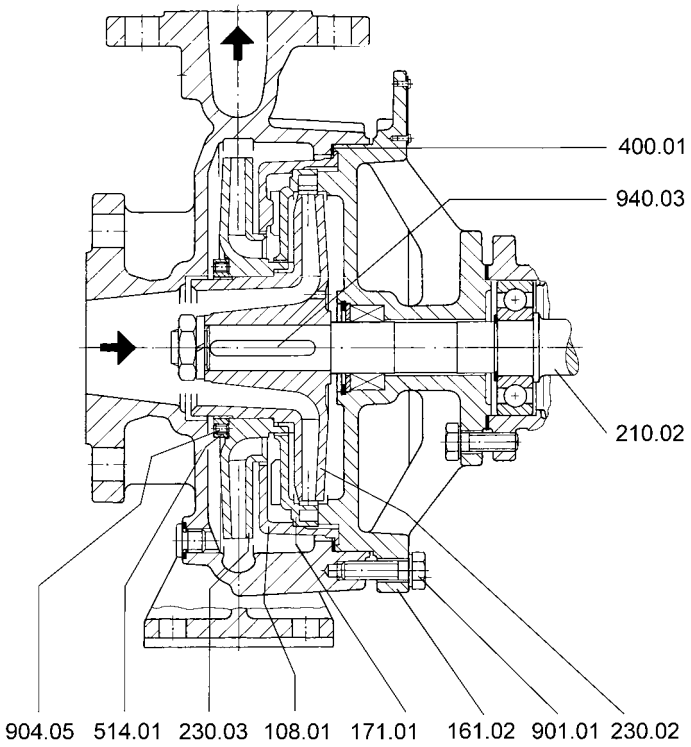
Sizes at bearing bracket sizes 530 and 650



Shaft sealing: Uncooled, unbalanced mechanical seal with safety stuffing box arranged in front

Abbreviation: **U 5 A**

Sectional drawing for two-stage sizes
Sizes at bearing bracket size 360



Shaft sealing: Uncooled, unbalanced mechanical seal with safety stuffing box arranged in front

Abbreviation: **U 5 A**

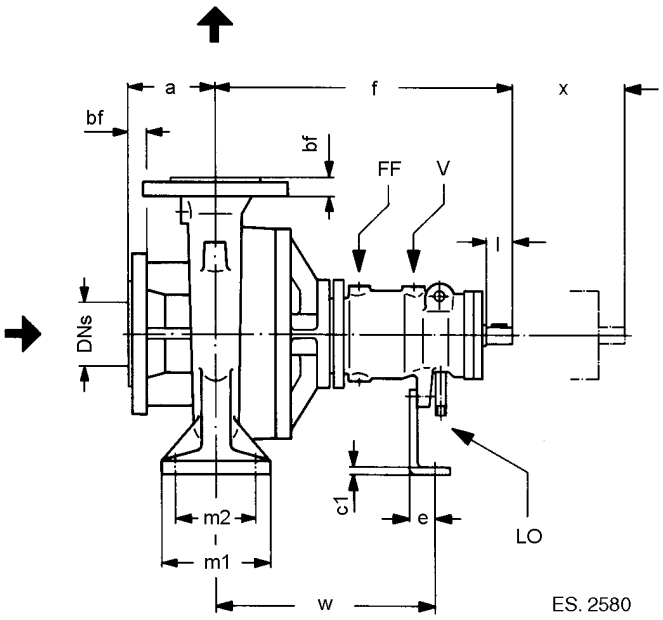
Denomination	Part No.
Volute casing	102.01
Stage casing	108.01
Casing cover	161.01
Casing cover	161.02
Diffuser	171.01
Supporting foot	183.01
Shaft	210.01
Shaft	210.02
Impeller	230.01
Impeller 1st stage	230.02
Impeller 2nd stage	230.03
Grooved ball bearing	321.01
Grooved ball bearing	321.02
Bearing bracket	330.01
Bearing cover	360.02
Gasket	400.01
Gasket	400.02
Gasket	400.03
Joint ring	411.02
Joint ring	411.06
Joint ring	411.07
Joint ring	411.09

Denomination	Part No.
Mechanical seal	433.01
Gland packing	461.01
Intermediate ring	509.01
Threaded ring	514.01
Nilos ring	516.02
Spacer sleeve	525.02
Tension sleeve	531.01
Disc	550.01
Disc spacer	551.01
Disc spacer	551.04
Disc spacer	551.05
Rivet	565.01
Rivet	565.02
Pipe	710.01
Hexagonal screw	901.01
Hexagonal screw	901.02
Hexagonal screw	901.03
Hexagonal screw	901.13
Stud bolt	902.01
Screwed plug	903.02
Screwed plug	903.06
Screwed plug	903.07

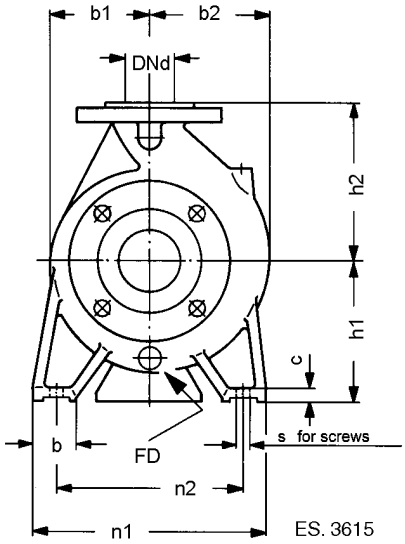
Denomination	Part No.
Screwed plug	903.09
Grub screw	904.05
Socket-head cap screw	914.08
Nut	920.01
Impeller nut	922.01
Circlip	932.01
Circlip	932.02
Circlip	932.04
Spring disc	934.01
Spring ring	936.01
Key	940.01
Key	940.02
Key	940.03
Name plate	971.01
Information plate	972.01

Connections	
FD	Draining
FF	Filling
LO	Leakage outlet
V	Venting

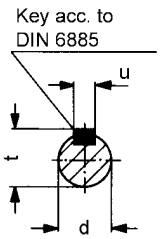
Pump dimensions
Size at bearing bracket sizes 360, 470, 530 and 650



ES. 2580



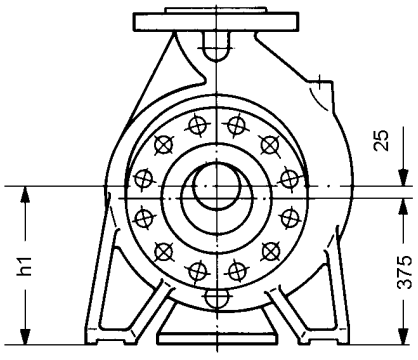
ES. 3615



ES. 1656

Bearing bracket size	Connections			
	Draining	Filling	Leakage outlet	Venting
	FD ④	FF	LO	V
360	G ¼	G ¼		
470	G ⅜			
530				
650				

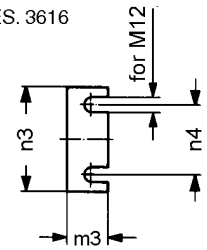
④ Connection FD in sizes 25-160/11, 25-200/01 and 2/25-200/01 each G ½

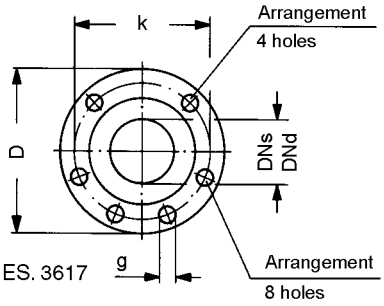


ES. 3619

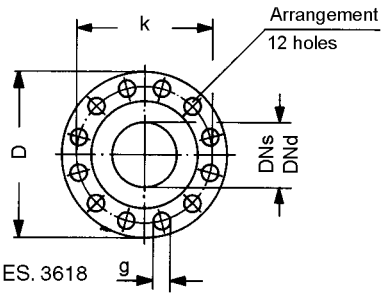
With size 250-400/01 only

ES. 3616





ES. 3617



ES. 3618

Flanges acc. to EN 1092-2 PN 16					
DN_s / DN_d	D	bf	k	g	No. of holes
25	115	16	85	14	4
32	140	18	100	19	4
40	150	18	110	19	4
50	165	20	125	19	4
65	185	20	145	19	4
80	200	22	160	19	8
100	220	24	180	19	8
125	250	26	210	19	8
150	285	26	240	23	8
200	340	30	295	23	12
250	405	32	355	28	12
300	460	32	410	28	12

Tolerances of companion dimensions acc. to DIN EN 735.
Sense of rotation: clockwise, as seen from the driving side.
Dimensions in mm without commitment.

Bearing bracket size	Pump size	Suction flange	Delivery flange	Pump dimensions						Feet dimensions											for screws	Extension dim. ⑥	Shaft end acc. to DIN 784			
		DN_s	DN_d	a	f	b1	b2	h1	h2	b	c	c1	e	m1	m2	m3	n1	n2	n3	n4	w	s	x	d	l	t	u
360	25-160/11 ⑤	40	25	80	360	125	125	132	160	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	25-200/01 ⑤	40	25	80	360	132	132	160	180	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	2/25-200/01 ⑤	40	25	80	360	132	132	160	180	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	32-160/01	50	32	80	360	130	130	132	160	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	32-200/01	50	32	80	360	124	130	160	180	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	2/32-200/01 ⑤	50	32	80	360	124	130	160	180	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	40-160/01	65	40	80	360	130	130	132	160	50	15	4	28	100	70	45	240	190	160	110	260	M12	80	24	50	27	8
	40-200/01	65	40	100	360	125	135	160	180	50	15	4	28	100	70	45	265	212	160	110	260	M12	80	24	50	27	8
	40-250/01	65	40	100	360	150	156	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	80	24	50	27	8
	2/40-250/01 ⑤	65	40	100	360	150	156	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	80	24	50	27	8
	50-160/01	65	50	100	360	125	130	160	180	50	15	4	28	100	70	45	265	212	160	110	260	M12	80	24	50	27	8
	50-200/01	65	50	100	360	133	145	160	200	50	15	4	28	100	70	45	265	212	160	110	260	M12	80	24	50	27	8
	50-250/01	65	50	100	360	156	169	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	80	24	50	27	8
	2/50-250/01 ⑤	65	50	100	360	156	169	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	80	24	50	27	8
	65-160/01	80	65	100	360	133	162	160	200	65	15	4	28	125	95	45	280	212	160	110	260	M12	100	24	50	27	8
	65-200/02	80	65	100	360	160	170	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	100	24	50	27	8
	80-160/01 ⑤	100	80	125	360	136	170	180	225	65	15	4	28	125	95	45	320	250	160	110	260	M12	100	24	50	27	8
	100-160/01 ⑤	125	100	125	360	165	200	200	280	65	15	4	28	125	95	45	320	250	160	110	260	M12	100	24	50	27	8
470	65-250/01	80	65	100	470	164	184	200	250	80	18	4	28	160	120	45	360	280	160	110	340	M16	100	32	80	35	10
	65-315/01	80	65	125	470	202	219	225	280	80	25	6	30	160	120	47	400	315	160	110	340	M16	100	32	80	35	10
	65-400/01 ⑤	80	65	125	470	239	255	250	355	80	25	6	30	160	120	47	420	335	160	110	340	M16	100	32	80	35	10
	80-200/02	100	80	125	470	172	190	180	250	65	18	4	28	125	95	45	345	280	160	110	340	M12	100	32	80	35	10
	80-250/01	100	80	125	470	185	210	200	280	80	18	4	28	160	120	45	400	315	160	110	340	M16	100	32	80	35	10
	80-315/01	100	80	125	470	210	231	250	315	80	25	6	30	160	120	47	400	315	160	110	340	M16	100	32	80	35	10
	100-200/01	125	100	125	470	165	203	200	280	80	18	4	28	160	120	45	360	280	160	110	340	M16	120	32	80	35	10
	100-250/01	125	100	140	470	189	224	225	280	80	18	6	30	160	120	47	400	315	160	110	340	M16	120	32	80	35	10
	100-315/01	125	100	140	470	220	250	250	315	80	25	6	30	160	120	47	400	315	160	110	340	M16	120	32	80	35	10
	125-200/01 ⑤	150	125	140	470	196	236	250	315	80	18	6	30	160	120	47	400	315	160	110	340	M16	120	32	80	35	10
	125-250/01	150	125	140	470	212	255	250	355	80	18	6	30	160	120	47	400	315	160	110	340	M16	120	32	80	35	10
	150-200/01 ⑤	200	150	160	470	214	268	280	370	100	27	6	30	200	150	47	550	450	160	110	340	M20	120	32	80	35	10
530	80-400/02 ⑤	100	80	125	530	261	282	280	355	80	25	6	31	160	120	47	435	355	160	110	370	M16	140	42	85	45	12
	100-400/02	125	100	140	530	268	292	280	355	100	27	6	31	200	150	47	500	400	160	110	370	M20	140	42	85	45	12
	125-315/01	150	125	140	530	226	252	280	355	100	27	6	31	200	150	47	500	400	160	110	370	M20	140	42	85	45	12
	125-400/02	150	125	140	530	264	283	315	400	100	27	6	31	200	150	47	500	400	160	110	370	M20	140	42	85	45	12
	150-250/02 ⑤	200	150	160	530	230	285	280	375	100	27	6	31	200	150	47	500	400	160	110	370	M20	140	42	85	45	12
	150-315/01	200	150	160	530	239	271	280	400	100	27	6	31	200	150	47	550	450	160	110	370	M20	140	42	85	45	12
	150-400/02	200	150	160	530	277	305	315	450	100	27	6	31	200	150	47	550	450	160	110	370	M20	140	42	85	45	12
	200-250/02 ⑤	200	200	180	530	265	330	355	425	100	27	6	31	200	150	47	550	450	160	110	370	M20	140	42	85	45	12
650	200-315/01 ⑤	250	200	200	650	275	335	355	450	110	27	10	42	200	150	65	550	450	250	200	455	M20	180	60	105	64	18
	200-400/01 ⑤	250	200	180	650	315	374	355	500	100	30	10	42	200	150	65	550	450	250	200	455	M20	180	60	105	64	18
	250-315/01 ⑤	300	250	250	650	325	408	400	560	130	30	10	42	260	190	65	690	560	250	200	455	M24	180	60	105	64	18
	250-400/01 ⑤	300	250	225	650	350	440	400	600	120	30	10	42	280	200	65	630	500	250	200	455	M27	180	60	105	64	18

⑤ Additional size

⑥ The spacer of the coupling can be larger than the required extension dimension.

Tolerances of companion dimensions acc. to DIN EN 735.

Dimensions in mm without commitment.

Successful in important branches

Decades of experience and branch-specific know-how ensure solutions that are practical and dependable. In addition to individual units with a motor or with a free shaft end, you can get complete systems and customer-specific cast parts from ALLWEILER AG. You are not just investing in machines with ALLWEILER AG. You are also profiting from decades of know-how about applications and processes in your branch.

You will find pumps and systems by ALLWEILER AG in the following sectors:

- **Marine and Offshore**
  Made of particularly corrosion-resistant, saltwater-proof materials and in accordance with specific standards (shock testing, national marine, international classifications, etc.).

- **Power Generation**
  Block and twin units for fuel and water injection in gas and steam turbines.
  For fuel supply, injection and lubricating oil delivery in power plants.

- **Water and Wastewater**
  Pumps for water treatment; share of dry solids content up to 45 percent; macerators, which make is possible to pump delivery media that are high in fibre and solids.

- **Process Engineering and Chemical Industry (ATEX-conformity)**
  Shaft bearing, shaft seal and material designs in accordance with the chemical characteristics of the delivery media. Magnetic coupling for hermetically sealed pumps.

- **Building Industry**
  Special units for oil furnace and lift systems. oil submersible pumps for all types of hydraulic machines.

- **Food and Pharma**
  Stainless steel pumps with CIP and SIP design, EHEDG and FDA certified. Especially for the careful delivery and proportioning of even sticky, paste-like and solids-rich media.

- **Tool Machinery**
  Designed for large delivery amounts or a high delivery pressure; resistant to contaminants and foreign materials. Especially for cooling lubricant supply.

- **Pulp and Paper**
  Pumps with extremely high availability (24 hours; 365 days) and many sizes, starting with small proportioning pumps and ranging to large Kaolin feeding pumps.

- **Heat Transfer**
  In supply circuits, circulating systems and heating circuits for the delivery of hot water and heat-transfer oil up to 207 °C and 450 °C.

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VM 500 GB/09.04 – Ident No. 795 277

COLFAX Fluid Handling

Charact. curves
NT 25-160/01

Quotation / Offer No.

Project ID

Charact. curves acc. **DIN EN ISO 9906** Class 2
Admissible minmum capacity 10 % * Q(opt) at continous operation
Remarks:

Item:
Pos.No:

Created by
GR-B, -

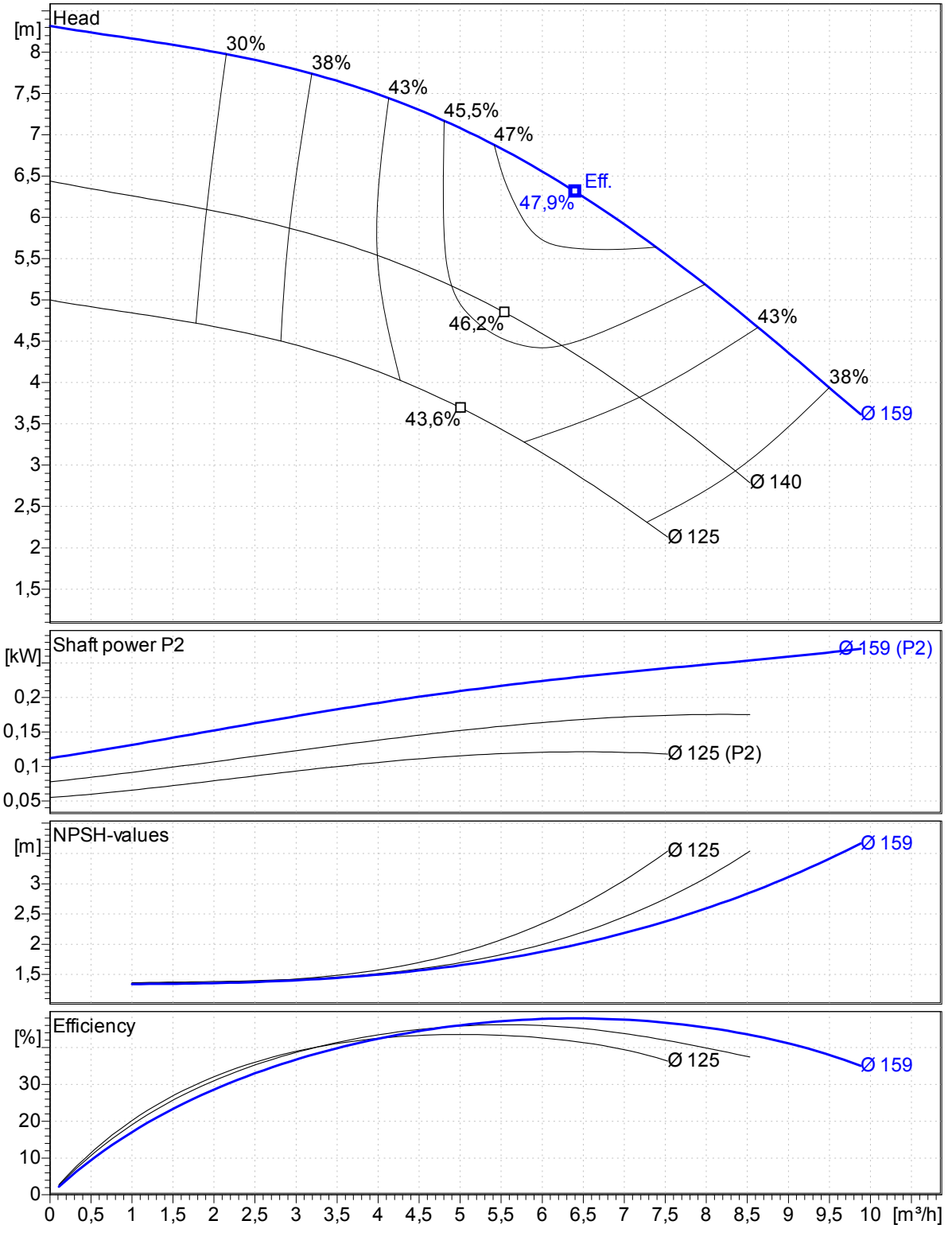
Date
2012-12-11

Power data referred to: **Water, pure**

	Q	H	P	Vis	Temp	Density	rated Torque
1)				1,0 mm²/s	20,0 °C	1,00 kg/dm³	
2)							

Speed
1450 1/min

NPSH-value without safety margins



F. MEDICIONES Y PRESUPUESTO

En este capítulo se presenta las mediciones desglosadas de materiales y trabajos, y el presupuesto, para la ejecución de la instalación solar térmica experimental de colectores cilindro parabólico.

F1. **Mediciones**

ID	Materiales	Descripción
M1-000	Sistema de colectores cilindro parabólico	
M1-100	Sistema de colectores cilindro parabólico. PTMx18	Sistema de colectores cilindro parabólicos de seguimiento y concentración solar térmico, compuesto por un colector PTMx18. Área de apertura de 41 m2. Capacidad máxima de 30,5 kW. Provisto de PLC, motoreductor y accesorios mecánicos, eléctricos y electrónicos para funcionamiento autónomo, seguro y fiable. Provisto de SAI. Certificado CE.
M1-001	Accesorio - HMI. Panel táctil 3,8"	Pantalla táctil de 3,8"
M1-002	Accesorio - Conjunto de medición de energía	Conjunto de medición energética, integrado en sistema de control y monitorización, compuesto por transmisor de temperatura de entrada, transmisor de temperatura de salida y transmisor de caudal.
M1-003	Accesorio - Sensor de radiación solar directa	Sensor de radiación energética, integrado en sistema de control y monitorización. No certificado.
M2-000	**Sistema de transporte de calor**	
M2-001	Fluido térmico. Therminol 66	Aceite térmico de transporte de calor. Rango de aplicación: 0 - 345ºC. Suministrado en bidón de 200 litros
M2-002	Intercambiador de calor. INT-004-10-I	Intercambiador de calor de carcasa y tubos. Temperatura de diseño: 300ºC. Presión de diseño: 600 kPa. Superfície de intercambio: 4 m2. Aceite térmico en tubos. Agua caliente en carcasa. Construcción en acero inoxidable. Conexionado de tubos por bridas DN25 PN16. Conexionado de carcasa por bridas DN32 PN16. Provisto de adaptadores. DN25/DN32 en tubos. Provisto de juntas de estanqueidad. Certificado CE.
M2-003	Bomba de circulación	Bomba de circulación centrífuga. Construcción de cuerpo en fundición nodular. Recubrimiento anti

	ALLWEILER NTT-25-160	corrosión. Temperatura de diseño: 350ºC. Presión de diseño: PN16. Provisto de motor eléctrico. Altura máxima desarrollada: 8,3 m de agua. Poténcia máx. desarollada en eje: 0,3 kW. NPSH máx. requerida: 3 m de agua. Eficiencia de bomba: 48%. Certificado CE
M2-004	Bomba de llenado y vaciado	Bomba de llenado y vaciado de desplazamiento positivo. Caudal nominal de 0,83 dm3/s. Provisto de manguera metálica de conexionado por rosca. Provisto de motor eléctrico.
M2-005	Depósito de expansión	Depósito de 50 litros. Construcción de fundición nodular. Recubrimiento de anti corrosión. Presión de diseño: 300 kPa. Temperatura de diseño: 300ºC. Provisto de indicador e interruptor de nivel. Certificado CE. Provisto de conexionado por bridas de PN16.
M2-006	Depósito de recogida y sellado	Depósito de 100 litros. Construcción de fundición nodular. Recubrimiento de anticorrosión. Presión de diseño: 300kPa. Temperatura de diseño: 300ºC. Provisto de accesorios de purga. Provisto de tabique de sellado hidráulico. Provisto de accesorio de venteo atmosférico. Certificado CE.
M2-007	Accesorio - Tuberías	Tuberías DN32. Construcción de fundición nodular. Recubrimiento anti corrosión. Presión de diseño PN16. Temperatura de diseño: 300ºC. Conexionado por bridas PN 16.
M2-008	Accesorio - Válvula de compuerta	Válvula de compuerta DN32. Cuerpo y fuelle de fundición nodular. Recubrimiento anti corrosión. Prensaestopas de seguridad. Presión de diseño: PN16. Temperatura de diseño: 300ºC. Conexionado por bridas PN16.
M2-009	Accesorio - Válvula anti retorno	Válvula antiretorno DN32. Construcción de fundición nodular. Presión de diseño: PN16. Temperatura de diseño: 300ºC. Conexionado por bridas PN16.
M2-010	Accesorio - Válvula de seguridad	Valvula de seguridad. Presión de diseño: PN16. Temperatura de diseño: 300ºC. Tipo estanco. Conexionado por bridas PN16.

M2-011	Válvula de control de tres vías	Válvula de tres vías diversora de accionamiento eléctrico. Temperatura de diseño: 300ºC. Presión de diseño: PN16. Provisto de motor eléctrico. Poténcia máx. consumida: 6,6 W. Certificado CE. Conexionado por bridas PN16.
M2-012	Accesorio - Filtro	Filtro de Tipo Y DN32. Construcción de fundición nodular. Presión de disño: PN16. Temperatura de diseño: 300ºC.
M2-013	Accesorio - Conjunto de bridas, juntas y tornilleria	Conjunto de bridas, juntas de estanqueidad y tornilleria de conexionado de tuberías y accesorios. Presión de diseño PN16. Temperatura de diseño: 300ºC. Tipo estanco.
M2-014	Accesorio - Termómetro	Termómetro. Temperatura de diseño 300ºC. Rango de medición: 0 - 300ºC. Provisto de accesorios de conexionado a tubería: grifos de cierre, vaina, juntas de estanqueidad etc.
M2-015	Accesorio - Manómetro	Manómetro. Temperatura de diseño 300ºC. Rango de medición: 0 - 600 kPa. Provisto de accesorios de conexionado a tubería: grifos de cierre, liras de dilatación, juntas de estanqueidad etc.
M3-000	**Sistema de control y monitorización**	
M3-001	Ordenador portátil personal	Ordenador portátil personal para funciones de monitorización y control remoto de sistema.
M3-002	Autómata programable	Autómata programable para operaciones de control, monitorización y registro de mediciones energéticas. Señales digitales de entrada: 7. Señales digitales de salida: 5. Señales analógicas de entrada: 3. Provisto de puerto Ethernet para comunicación con ordenador personal portátil. Memoria de datos de 100k words. Provisto de batería. Provisto de adaptador de alimentación 230VAC/24VDC. Provisto de accesorios para satisfacer número de señales, memoria o puertos.
M3-003	Interruptor de nivel	Interruptor de nivel bajo en depósito de expansión, para bloqueo de sistema en caso de rotura de tubería o fugas de aceite térmico de circuito primario. Señal

		digital. Compatible con condiciones de diseño de proceso.
M3-004	Interruptor de presión	Interruptor de presión alta y baja en secundario de intercambiador, para bloqueo de sistema para prevenir cavitación o sobrepresión. Señal digital. Compatible con condiciones de diseño de proceso.
M3-005	Interruptor de presión diferencial	Interruptor de presión diferencial bajo en secundario presión intercambiador, para bloqueo de sistema para prevenir sobrecalentamiento. Señal digital. Compatible con condiciones de diseño de proceso.
M3-006	Transmisor de temperatura	Transmisor de temperatura en entrada y salida de secundario de intercambiador para funciones de monitorización de energía. Señal analógica. Compatible con condiciones de diseño de proceso.
M3-007	Transmisor de caudal	Transmisor de caudal en secundario de intercambiador para funciones de monitorización de energía. Señal analógica. Compatible con condiciones de diseño de proceso.
M3-008	Accesorios - Conductores, racks, canalizaciones y cubiertas	No especificado
M4-000	**Sistema eléctrico**	
M4-001	Cuadro eléctrico	No especificado
M4-002	Variador de frecuencia	No especificado
M4-003	Accesorios - Protecciones eléctricas	No especificado
M4-004	Accesorios - Contactores, relés y temporizadores	No especificado
M4-005	Accesorios - Conductores, racks,	No especificado

	canalizaciones y cubiertas	
M5-000	**Bancadas y estructuras metálica**	
M5-001	Bancada metálica	Bancada metálica de colectores cilindro parabólico
M5-002	Bancada y estructura metálica	Bancada y estructura metálica de sistema de transporte de calor

F2. **Presupuesto**

ID	Producto	Dimensión	Unidad	Coste unitario	Coste
M1-000	**Sistema de colectores cilindro parabólico**				25000,00
M1-100	Sistema de colectores cilindro parabólico (1x PTMx18)	1	u	22000,00	22000,00
M1-001	HMI. Panel táctil 3,8"	1	u	500,00	500,00
M1-002	Conjunto de medición de energía	1	u	1800,00	1800,00
M1-003	Sensor de radiación solar directa	1	u	700,00	700,00
M2-000	**Sistema de transporte de calor**				21127,00
M2-001	Therminol 66	1	u	2349,00	2349,00
M2-002	Intercambiador de calor.INT-004-10-I	1	u	6480,00	6480,00
M2-003	Motobomba de circulación ALLWEILER NTT-25-160	1	u	2566,00	2566,00
M2-004	Motobomba de llenado y vaciado	1	u	642,00	642,00
M2-005	Depósito de expansión	1	u	1364,00	1364,00
M2-006	Depósito de recogida y sellado	1	u	1126,00	1126,00
M2-007	Accesorio - Tuberías	60	m	50,00	3000,00

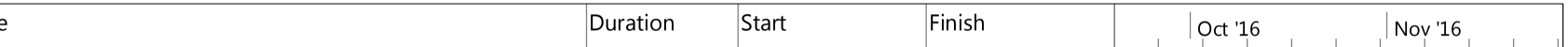
M2-008	Accesorio - Válvula de compuerta	6	u	100,00	600,00
M2-009	Accesorio - Válvula anti retorno	1	u	100,00	100,00
M2-010	Accesorio - Válvula de seguridad	1	u	200,00	200,00
M2-011	Válvula de control de tres vías	1	u	1500,00	1500,00
M2-012	Accesorio - Filtro	1	u	100,00	100,00
M2-013	Accesorio - Conjunto de bridas, juntas y tornilleria	1	u	500,00	500,00
M2-014	Accesorio - Termómetro	2	u	150,00	300,00
M2-015	Accesorio - Manómetro	2	u	150,00	300,00
M3-000	**Sistema de control y monitorización**				6700,00
M3-001	Ordenador portátil personal	1	u	1000,00	1000,00
M3-002	Autómata programable	1	u	2500,00	2500,00
M3-003	Interruptor de nivel	1	u	200,00	200,00
M3-004	Interruptor de presión	2	u	200,00	400,00
M3-005	Interruptor de caudal	1	u	200,00	200,00
M3-006	Transmisor de temperatura	2	u	200,00	400,00
M3-007	Transmisor de caudal	1	u	1000,00	1000,00
M3-008	Accesorios - Conductores, racks, canalizaciones y cubiertas	1	u	1000,00	1000,00
M4-000	**Sistema eléctrico**				2500,00
M4-001	Cuadro eléctrico	1	u	100,00	100,00
M4-002	Variador de frecuencia	1	u	1000,00	1000,00
M4-003	Accesorios - Protecciones eléctricas	1	u	200,00	200,00

M4-004	Accesorios - Contactores, relés y temporizadores	1	u	300,00	200,00
M4-005	Accesorios - Conductores, racks, canalizaciones y cubiertas	1	u	1000,00	1000,00
M5-000	**Bancadas y estructuras metálica**				7500,00
M5-001	Bancada metálica	1	u	5000,00	5000,00
M5-002	Bancada y estructura metálica	1	u	2500,00	2500,00
TOTAL					62827,0

G. PLANIFICACIÓN

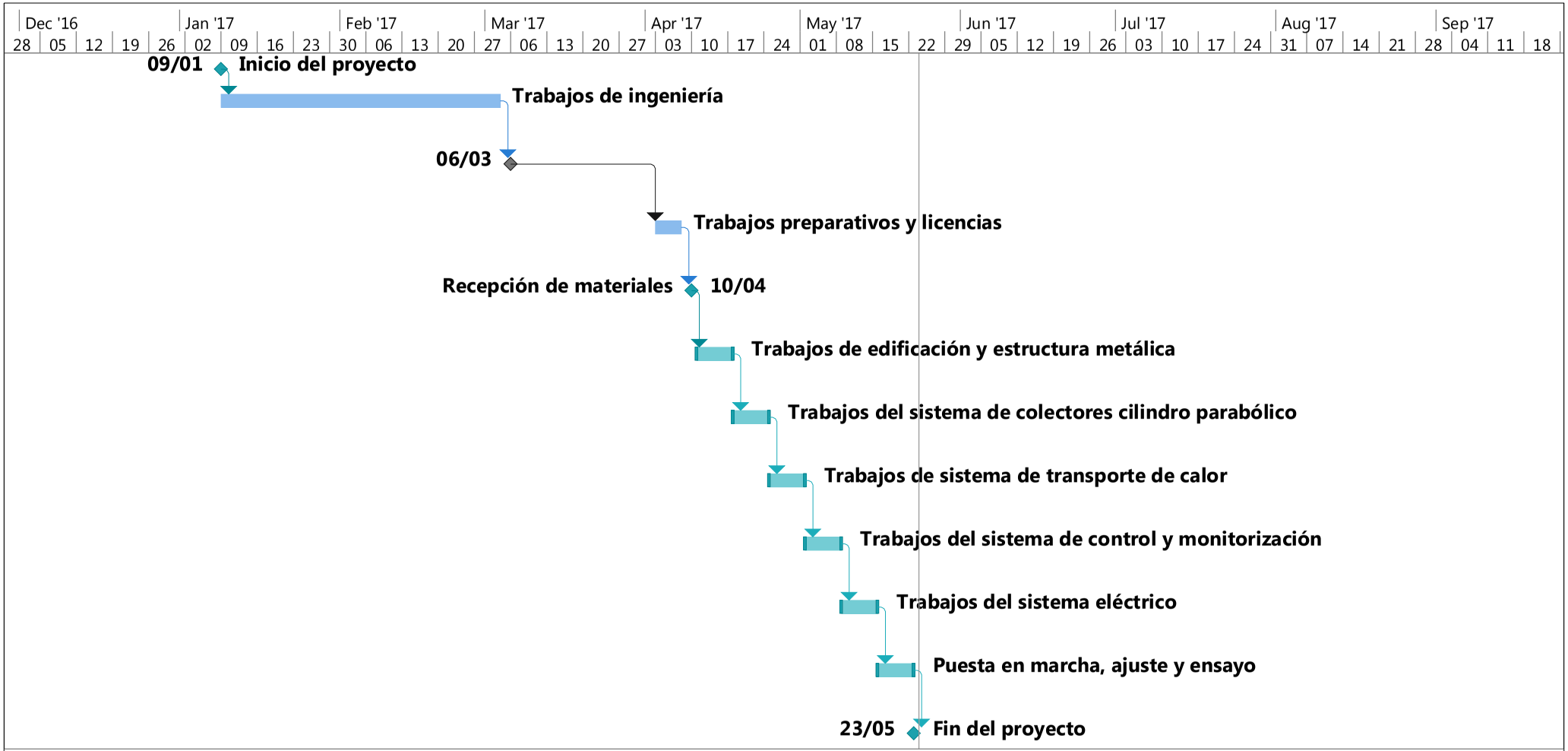
En este capítulo se presenta la planificación de la ejecución de la instalación solar térmica experimental de colectores cilindro parabólico. En primer lugar se presenta en formato tabla con indicación de fechas de inicio y final de los trabajos, y en segundo lugar se presenta en formato de un diagrama de Gantt.

ID	Task Mode	Task Name	Duration	Start	Finish
1		1 Inicio del proyecto	0 days	Mon 09/01/17	Mon 09/01/17
2		2 Trabajos de ingeniería	40 days	Mon 09/01/17	Fri 03/03/17
3					
4		3 Revisión de proyecto (Buffer)	0 days	Mon 06/03/17	Mon 06/03/17
5					
6		4 Trabajos preparativos y licencias	5 days	Mon 03/04/17	Fri 07/04/17
7					
8		5 Recepción de materiales	0 days	Mon 10/04/17	Mon 10/04/17
9					
10		6 Trabajos de edificación y estructura metálica	5 days	Tue 11/04/17	Mon 17/04/17
11					
12		7 Trabajos del sistema de colectores cilindro parabólico	5 days	Tue 18/04/17	Mon 24/04/17
13					
14		8 Trabajos de sistema de transporte de calor	5 days	Tue 25/04/17	Mon 01/05/17
15					
16		9 Trabajos del sistema de control y monitorización	5 days	Tue 02/05/17	Mon 08/05/17
17					
18		10 Trabajos del sistema eléctrico	5 days	Tue 09/05/17	Mon 15/05/17
19					
20		11 Puesta en marcha, ajuste y ensayo	5 days	Tue 16/05/17	Mon 22/05/17
21					
22		12 Fin del proyecto	0 days	Tue 23/05/17	Tue 23/05/17



Project: Proyecto
Date: Sun 27/03/16

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress



Project: Proyecto
Date: Sun 27/03/16

Task		Inactive Summary		External Tasks	
Split		Manual Task		External Milestone	
Milestone		Duration-only		Deadline	
Summary		Manual Summary Rollup		Progress	
Project Summary		Manual Summary		Manual Progress	
Inactive Task		Start-only			
Inactive Milestone		Finish-only			

H. PLANOS Y DIAGRAMAS

En este capítulo se presenta la distribución en planta y esquemas preliminares de la instalación solar térmica experimental de colectores cilindro parabólico.

- Distribución en planta (Referencia L.1.000)
- Diagrama de proceso (Referencia PFD.1.000)
- Diagrama de proceso e instrumentación (Referencia PID.1.000)
- Diagrama eléctrico (Referencia E.1.000)